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THE JOURNAL OF NEUROLOGY AND PSYCHOPATHOLOGY

Vol. XIII. JULY, 1932. No. 49.

Original Papers.

HÆMORRHAGIC AFFECTION OF CORTICO-NEOSTRIATAL SITE REVEALED CLINICALLY BY ACUTE AND FATAL CHOREA.

By

LUDO VAN BOGAERT, Antwerp, and IVAN BERTRAND, Paris.

The pathogenic problem of choreic and athetotic syndromes is far from being finished. A strictly striatal origin seems to be rendered doubtful on both theoretical and factual grounds; and it is the meritorious work of S. A. K. Wilson that has replaced the study of this complex type of involuntary movement on a physiological basis.

As a result of his researches, Wilson assigns to choreo-athetosis the validity of a syndrome connected not with unchanging lesions of a fixed apparatus but due to involvement of a system in which the cerebral cortex is one of the nodal points. This conception permits the integration, in one physiopathological totality, of choreo-athetoses from lesions of the cerebellar peduncles, of the thalamostriatal apparatus, and finally from those accompanying frontoparietal lesions to which he has given special attention. Wilson's hypothesis has been accepted by some writers and rejected by others. It is open to discussion not solely in respect of its anatomical basis; nevertheless every careful clinicoanatomical observation deserves to be documented and pondered over. The following observation furnishes support to the views of Wilson because of the extent of the frontoparietal lesions contrasted with the preservation of the cerebellothalamic system. It is not, however, a pure case; the involvement of the neostriatum is of importance. The extreme acuity of the case, which evolved in 36 hours and culminated in death, confers on it an exceptional clinical character.

PERSONAL CASE.

Rah . . . , male, age 28, cabinetmaker, enjoyed normal health to the age of 20. During his term of military service he contracted an acute and serious

polyarthritis, complicated by a systolic murmur at the apex. The affection seemed to disappear spontaneously, and from 21 to 25 he appeared healthy enough. A relapse occurred in 1927, the joints of the legs, especially the ankles, being concerned. He lay in bed for three months, then resumed his trade.

On February 16, 1930, at home after work, he felt violent pains in his head and was nauseated and fatigued. His tongue was coated. The headache was localized mainly above the eyes and over the forehead; a degree of photophobia was experienced. All the limbs ached, but no paralysis was present. Pulse-rate 110; temp. 38·6° C.

During the night his brother found him groaning, rolling about the bed, muttering unintelligible words, the prey to unceasing agitation, and recognising no one. By way of answer to questions he put his hands to his forehead. He kept beating his head against the bed, threw himself about, and knocked his left arm against the wall till it was covered with bruises. There was no complaint of diplopia; involuntary micturition occurred. At 3 a.m. the temperature was 39·1°. The motor agitation became ever more violent, necessitating his removal to hospital at about 4 a.m. On admission his temperature was 40·2°, his pulse 110; respiration was quick and shallow.

He was seen by us on the morning of February 17. Thin, and covered with ecchymoses, he was in the grip of clown-like movements recalling certain theatrical attitudes of hysteria but more abrupt and rapid than we have ever seen. From the time of his admission two attendants had been watching him and holding him down, for the movements were violent enough to toss him on to the floor. Mattresses were arranged against the wall to diminish the risk of injury. His face was flushed, his eyeballs turned up at intervals, his glance changing so that it was impossible to catch his eye. It was doubtful if he recognised us. The head was seized with movements of hyperextension as he lay on the bed, accompanied by extension of the trunk in an arc de cercle, while the arms were raised. From time to time champing and opening movements of the jaws occurred, and movements of swallowing, accompanied by grimaces like those of athetosis. He made no cries, emitting only raucous guttural sounds. Occasionally a little blood trickled on the lips, from biting of the tongue or friction movements. The opisthotonic contractions were often lateral, the opposite leg crossing in semiflexion the leg of the side to which he was turning. During this time the arms were elevated violently, fingers extended, forearms in hyperpronation; such movements were nearly always bilateral and more or less symmetrical. The posture would be maintained for several minutes, then the muscles would relax, the limbs would sink to the bed; and after repose of some minutes another series would commence. In the lower limbs, the movements often consisted of uni- or bilateral extension with adduction, eversion of the feet, and extension of the great toes. The abdomen would retract, and it was not rare to observe the bladder empty itself spontaneously. Apart from the big movements of the upper limbs, held in the air like the sails of a windmill, grasping movements of the hands also were noted, and appeared to be voluntary. Objects seized in the hands were held with persistence. Occasionally, one of the arms came alongside the body and rotated inwards. The diaphragm took part in some movement-complexes. At other times the limbs were at rest while trunk and shoulders were the seat of bizarre contortions recalling the movements of Huntington's chorea.

Dominating the whole clinical picture were the amplitude, range, and violence of the movements, their asynchronicity, arrhythmia, and tendency to become generalized.

Examination was difficult because the patient violently withdrew any limb that was touched. This action set free a whole series of coarse movements necessitating his being immediately held to prevent his falling. Liquid was refused; sometimes he could be made to swallow a mouthful, but he choked and coughed, without return through the nostrils. He tried to bite those who were helping him to drink. The neck was stiff, but it could be rather easily made to relax, and there was no rigidity comparable to that of meningitis. Put on his feet, the patient was thrown down by the increasing violence of the movements. He could nevertheless maintain the erect posture, but the effort was interrupted by sudden loss of control of the limbs, and down he would go again. Walking was dominated by such involuntary acts.

The plantar reflex was indifferent on the two sides; the abdominals could not be tested. The pupils reacted to light. Tendon reflexes appeared feeble but were difficult to examine.

In the presence of this clinical syndrome we naturally thought of a superacute chorea whose violence we had never seen equalled even in the encephalitis of pregnant women. The motor disorder however was very different from that of Sydenham's chorea, in which the movements are more limited, milder, more selective and less brutal than in our case. Careful enquiry elicited no toxic cause. Blood urea and nitrogen turned out to be normal. Blood-sugar was down a little (0·71); in the urine was neither acetone, sugar, nor albumen, and no casts. The blood count gave 9,700 whites, with a lymphocytosis of 46 per cent. Blood cultures were made by Dr. Wittebroodt. A lumbar puncture could not be thought of unless under an anæsthetic. We were surprised at the rapidity with which quiet developed. Six minutes after the commencement of the anæsthesia the clown-like movements had all disappeared, leaving only the diaphragmatic contractions, the extensor movements of the legs and those of jaws and neck. These too vanished as the sleep became deeper. Babinski's sign was never present. By lumbar puncture performed with care at three different levels a hæmorrhagic fluid was got in all three tubes. It proved to be free of organisms.

Narcosis was prolonged in order to inject 500 c.c. physiological saline, and awakening was extremely slow. The motor disturbances returned in a certain order. First came the movements of mastication, protrusion of tongue, torsion movements of the neck, elevation of one shoulder, then more violent spasms of extension and elevation of the limbs. Only after two hours did all come back as before the anæsthesia, yet were less violent. Towards evening the patient was less agitated, but remained unconscious. The tendon reflexes were abolished in all four limbs, without Babinski's sign. During the night he became comatose and died towards morning.

To summarize: a young man who had had several attacks of acute polyarthritis, but none for three years, suddenly developed a superacute chorea terminating fatally in 36 hours.

The illness commenced with fever. It was not uræmic. Examination of different viscera revealed no trace of exogenous poison. Blood cultures were negative. In view of the antecedents an acute rheumatic encephalitis might be postulated, but only these antecedents could be adduced in favour of the speculation.

PATHOLOGICAL EXAMINATION.

The autopsy was made 18 hours after death, the brain having been hardened by formalin in situ. Lungs, intestines, heart and liver were normal. The spleen was twice the normal size and very friable. The

Fig. 1. Macroscopic appearance of the brain.

kidneys showed signs of degeneration and the capsule was more adherent than usual. Some myocardial degeneration was found, with petechial spots on the left side of the intraventricular septum. The valves were all normal, as were aorta and coronaries.

Macroscopic appearances.—The anterior two-thirds of the cerebral hemispheres were covered by a kind of hæmorrhagic sheet (without lesion or fracture of the cranium). This hæmorrhagic meningeal infiltration was most pronounced over the frontal poles and the rolandic areas (fig. 1). It was also well marked over the ascending parietal gyri, the superior parietal

and the supramarginal. It was much less intense over temporal and occipital regions. On the base, a vast hæmorrhagic sheet extended across the interpedunculo-chiasmatic space and insinuated itself past the hippocampus to the corpus callosum and anteriorly into the interhemispheric fissure. A series of vertico-transverse sections showed that the hæmorrhagic lesions of the brain were confined almost exclusively to the cerebral cortex and certain of the central ganglia.

The first section, through the genu of the corpus callosum, showed a hæmorrhagic infiltration of the head of the caudate nucleus, which stopped at the margin of the external capsule (fig. 2).

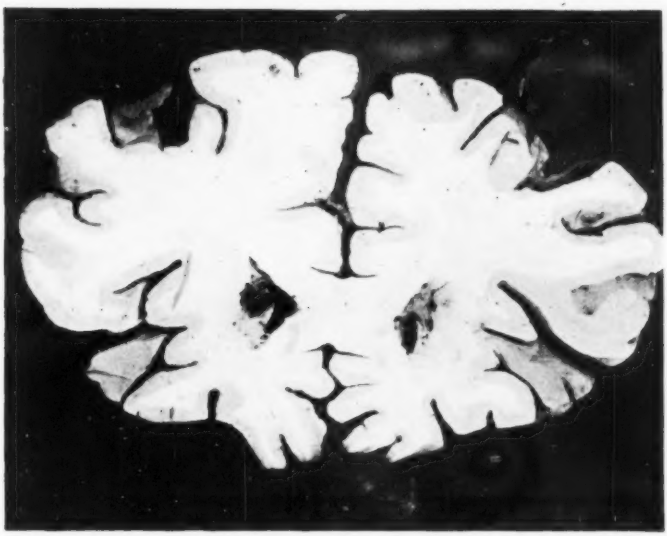

FIG. 2. Vertico-transverse section showing hæmorrhagic infiltration of the cortex and of first anterior part of the caudate nucleus, white matter being intact.

A second section passing a little in front of the anterior limb of the internal capsule showed the same hæmorrhagic lesion affecting frontal cortex, insula, claustrum and the upper two-thirds of the putamen. The body of the caudate nucleus was also much implicated. The anterior division of the optic thalamus, the infundibulotuberal region, the internal and external capsules, the hippocampus and the temporal pole were not involved.

A third section passing by the genu of the internal capsule, the posterior part of the putamen and the anterior part of the red nuclei, showed similar

hæmorrhagic lesions in the insula, ascending parietal, the paracentral lobules and limbic convolutions. The posterior part of the putamen, globus pallidus, posterior limb of internal capsule, locus niger and regio subthalamica were unaffected.

A fourth section passing behind the pes pedunculi, and 3 mm. in front of the splenium of the corpus callosum, showed that the paracentral lobules, superior and ascending parietal, and the præcuneus were much involved. The angular gyrus was slightly implicated. In the neighbourhood of the sylvian fissure the left inferior parietal was affected, but not the right.

FIG. 3. Infarcted appearance of the caudate nucleus (Nissl).

FIG. 4. Fissural hæmorrhage along the outer border of the putamen.

The morbid process was thus almost entirely hæmorrhagic, and limited to grey matter. The maximal lesions were in the anterior segment of the neostriatum, symmetrically on the two sides. The head of the caudate nucleus and the anterior part of the putamen presented an infarcted appearance (fig. 3). It looked like a hæmorrhagic softening without rigorous symmetry; analogous bilateral hæmorrhages involved the frontoparietal cortex. The external capsule escaped, but a linear sheet of hæmorrhage lay along the outer surface of the putamen, reproducing the 'cerebral hæmorrhage of Charcot.' It did not involve the white matter but developed at the expense of the putamen (fig. 4). The claustrum was well outside this lesion.

Histopathology.—A variable aspect was found in the corpus striatum; sometimes only a simple extravasation of red blood corpuscles in the perivascular spaces (fig. 5), sometimes a large extra-adventitial ring (fig. 6). In the latter circumstances, adjoining nervous tissue was necrosed (fig. 7). In sections stained by the method of Loyez a third type of perivascular lesion

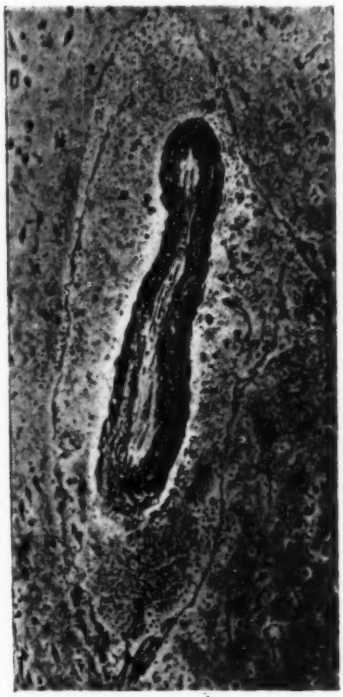

FIG. 5. Simple extravasation in the space of Virchow without involvement of extra-adventitial parenchyma (Bielschowsky).

was found, in which hæmorrhage was of minor significance; the vessel was surrounded by a pale aureole, staining less deeply than neighbouring grey matter and with scanty hæmorrhagic effusion (fig. 7). Every grade of lesion was found in proportion to the amount of hæmorrhage and necrosis.

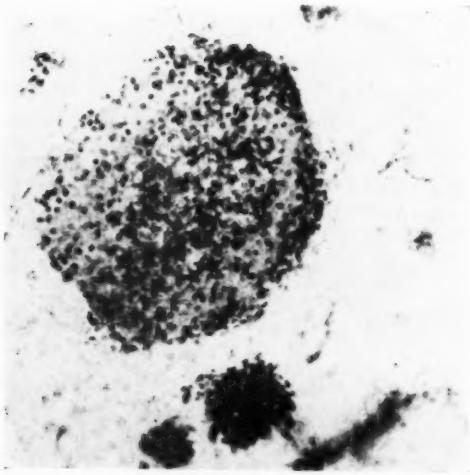

FIG. 6. Paravascular necrosis with haemorrhagic 'corona' (Nissl).

FIG. 7. Simple paravascular necrosis (Bielschowsky).

These lesions were seen in the caudate nucleus and to a less extent in the frontal cortex, in particular at the level of the first frontal, where involvement was most severe. Perivascular punctiform hæmorrhages were found in all the layers of the cortex, but those most implicated were the fourth, fifth, and sixth (fig. 8). In the cortex the necrotic foci were less numerous

FIG. 8. Paracapillary hæmorrhage in layers 2-6 of the frontal cortex, with cellular necroses (Bielschowsky).

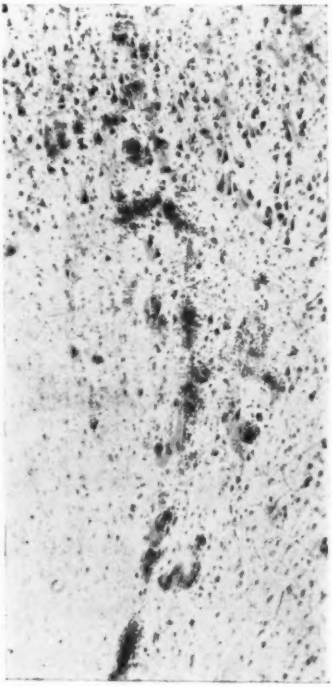

FIG. 9. Paracapillary hæmorrhages of subcortical white matter and of the innermost layer of the cortex ; slight changes in cellular architecture (Nissl).

than in the corpus striatum. Cellular architectonic was little modified (fig. 9). In the vicinity of the intracortical hæmorrhages the ganglion-cells were abnormally loaded with lipo-pigment. A certain number showed karyolysis and tigrolysis, not specially typical. Yet at certain spots, particularly at the foot of the sulci, plaques of ischæmic necrosis, well known

in cerebral arteriosclerosis, were characteristically present (fig. 10). No laminal destruction of any important and systematized kind was noted.

In addition, the molecular layer of the cortex showed a large number of pigmentary inclusions, also pigment lying free or enclosed in neuroglial and, in particular, microglial elements (fig. 11). In the neighbourhood of

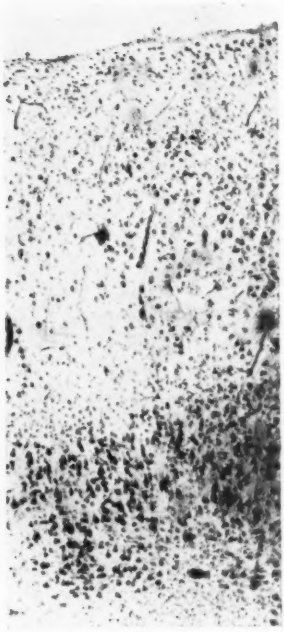

FIG. 10. Intracortical ischæmic necrosis (Nissl).

FIG. 11. Lipopigmentary infiltration of subpial motor cells and of microglial elements of the molecular layer in the vicinity of an intracortical hæmorrhagic focus (Nissl).

the hæmorrhagic regions this pigmentary impregnation of the molecular layer continued over a wide extent.

The white matter of the convolutions was as a rule normal. Hunt had to be made over the whole extent of a section to find minute apoplectic foci. At one place, however, in the white matter of the mesial aspect of the superior frontal, we found an area of necrosis accompanied by perivascular demyelinization round an axial vessel for a distance of several

millimetres (fig 12). This type of demyelinization is exactly comparable to what is currently seen in cases of postvaccinial encephalitis and we direct particular attention to the fact. In our case it was rare, since we discovered it in one place only.

The whole of the cerebral convexity in the vicinity of the superior longitudinal sinus was covered by a hæmorrhagic leptomeninx infiltrated with blood and penetrating into the sulci. A similar hæmorrhagic meningeal state was the sole lesion observed in connexion with the cerebellum. Its grey matter, white matter, dentate and roof nuclei were intact, as were pons and medulla. No appreciable changes were seen in peripheral nerves.

FIG. 12. Perivascular demyelinization in the white matter (Loyez).

Thus histopathological examination disclosed no more than a hæmorrhagic diapedesis in relation to small vessels, without inflammatory reaction, involving the grey matter of cortex and neostriatum. The diapedesis was sometimes replaced by a process of occlusion with perivascular necrosis, or by simple demyelinization without thrombosis or hæmorrhagic infiltration.

PHYSIOPATHOLOGY.

In view of the negative results of blood culture and of biological examination, it is difficult to interpret the case from a physiopathological standpoint. Whether the toxi-infective cause be rheumatic or not, it had without doubt determined a venous stasis over a wide area of the meningocephalic network, entailing the hæmorrhagic diapedeses already described. Nowhere in the brain were lesions of vascular walls found which could explain

mechanically the appearance of thrombotic or infarctive phenomena in adjoining tissues corresponding to vascular distributions; and in this respect our case supports present-day theories on the origin of cerebral softenings. It seems less and less probable that these are caused by anatomical ischæmia. The researches of Gildea and Cobb, of Wolff and Lennox and others, have shown that inadequate oxygenation, resulting from the stasis, is the cause of distention of vascular walls. The distension is soon followed by parenchymatous œdema with extravasation of erythrocytes and rapid cellular necrosis. This œdema blocks secondarily the blood current coming from neighbouring capillary networks at low pressure. In our case some general cause has induced the distention, which was soon succeeded by the eruption of reds into the arachnoid cisterns, the spaces of Virchow-Robin, extra-adventitial spaces, and even into the cerebral tissues themselves. At certain spots it has been complicated by extensive thromboses of small arteries and veins. Insufficient oxygenation also accounts for the presence of necrotic zones whose topography has already been mentioned.

The elective localization of the morbid processes is no less surprising, for the cortico-neostriatal distribution of the hæmorrhages cannot be explained by anatomical arrangements of the cerebral circulation, so far at least as present knowledge takes us. If the fissural hæmorrhage of the external capsule corresponds to a classical localization, the involvement of the cortico-subcortical grey matter with escape of the white eludes interpretation. The capillary network of the cortex has no terminals and is continuous on the one hand with that of the pia mater (Pfeiffer), and on the other with that of the basal ganglia (Cobb) across the centrum ovale. Then why do we not find the same hæmorrhagic diapedeses in the centrum ovale, where they are seen with the greatest frequency in other affections? It would appear we are here dealing with a toxi-infective agent having a special predilection for the cortico-neostriatal grey matter.

THE CHOREIC SYNDROME.

Has this case any light to throw on the pathology and physiopathology of the choreic syndrome, which are far from being settled despite recent work of much interest? In 1930 Lhermitte and Pagniez published an important paper in which they divided acute chorea into two main types: (1) an inflammatory type, analogous to choreic encephalitis, and (2) a degenerative type characterized by diffuse cerebral lesions associated with marked modifications of the vascular network, distinct from those of inflammatory processes. Their own observation belonged to the second class. The lesions were above all vascular and neuronal. Vasodilatation with pericapillary hæmorrhages was seen, thromboses, vascular ruptures, pronounced changes of cellular architecture with acute ganglionic lesions. The lesions were

diffuse, but Lhermitte and Pagniez mention the particularly severe involvement of dentate nuclei, putamino-caudate segments of the corpus striatum, and of the Purkinje cells of the cerebellum.

A similar distinctiveness is less apparent in the recent case of van Gehuchten combining the inflammatory formula of acute chorea and the degenerative type. In opposition to Lhermitte and Pagniez—who do not reject the idea of two different etiologies for the two types of lesions which they have differentiated—van Gehuchten believes that ' when an infection is superacute and entails rapid death, the lesions found at autopsy are of a definite infective type (vascular congestion, infiltration, infective nodules, cellular chromatolysis, commencing satellitosis); but when the infection is more diluted . . . a degenerative stage follows the first inflammatory stage; during it inflammatory reactions become progressively less, to disappear in certain cases even when neural degeneration follows.' Infective forms are always speedily fatal, from a few days to one or two weeks, whereas the degenerative forms evolve over a period of one or two months.

The case which is here described evolved in 36 hours and belongs to the degenerative type, but it does not fit in well with van Gehuchten's interesting interpretations. Apart from the type of lesions, their topography has to be considered. In the case of Lhermitte and Pagniez, they were mainly dentato-cerebellar and putamino-caudate; in that of van Gehuchten, thalamo-putamino-caudate. This latter topography, with more or less definite involvement of the cerebral cortex, is met with in the majority of reported cases. Our case substantiates in part the conclusions of van Gehuchten, that ' lesions of putamen, caudate, optic thalamus, complicated perhaps by changes in the cerebral cortex, are alone indispensable for the development of choreic symptoms.' We say ' in part,' for the optic thalamus was normal, while the cortex was involved just as heavily as the neostriatum.

In progressive cases of the type of Sydenham's chorea it is very difficult to say which are the parts first affected and responsible for the choreic syndrome. Diffuse infections lend themselves very badly to topical differentiation. Only by the critical study of numerous cases with limited localization will it be possible one day to specify the lesions whose incidence determines choreic liberation. No other purpose has been in view in the publication of this case.

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OBSERVATIONS ON THE DIAGNOSIS OF SPINAL BLOCK BY MEANS OF LIPIODOL.

By

H. H. MOLL, Leeds.

A valuable addition to the diagnosis of nervous disease was made by Sicard and Forestier when in 1922 they[1] successfully injected lipiodol into the cisterna magna in order to demonstrate spinal block.

In a fresh unaltered state lipiodol is a transparent oil of an amber yellow colour and of high specific gravity (1350); it is completely opaque to X-rays owing to the high atomic weight (127) of its iodine component, while its density causes it to fall by gravity from the cisterna magna to the lumbar cul-de-sac. If heated to 100° F. it becomes less viscid and therefore more easy to inject, but if it is exposed to a high temperature or to light and air it may turn a dark brown or greenish colour and iodine may be liberated in a free state. Lipiodol which has turned this colour should be discarded as the free iodine may irritate and give rise to untoward effects.

Rate of absorption and of elimination.—The rate of absorption and of excretion of lipiodol injected into the subarachnoid space is extraordinarily slow and even after two or three years some of the oil may still be seen in the subarachnoid space. After lipiodol has been injected into the cisterna magna it falls by its own weight to the most dependent parts but remains free to move up and down the space according to the position of the body. In the course of a few days it becomes fixed to the meninges, the oil is gradually absorbed through the lymphatics, and its iodine component is excreted through the kidneys. The excretion of iodine in the urine is relatively rapid during the first week and then falls considerably but continues as long as lipiodol remains visible. It has been calculated that after an injection of 2 cc. of lipiodol 2-3 mgm. of iodine are excreted in the urine the first week and thereafter the quantity gradually diminishes to 1 mgm. or less a day. In chronic inflammatory conditions such as luetic meningomyelitis, tabes dorsalis, and general paralysis of the insane the absorption of lipiodol may be more rapid.

Dangers.—The value of any one method of diagnosis must primarily depend upon its absolute safety. Some diffidence is naturally felt in adopting any new procedure until sufficient experience has proved it to be

both efficient and harmless. The enthusiasm of pioneer workers must be tempered by the criticism of later observers. Apart from any dangers which may arise through faulty technique the question naturally suggests itself whether lipiodol is really entirely harmless and non-irritating to the cord and the meninges.

Sicard[2] claims that there is no immediate reaction and that the passage of the oil along the spinal canal is not accompanied by pain or by any abnormal sensations. However, he goes on to say that in some cases delayed symptoms may occur from four to six hours after the injection, consisting of headache, slight cramps in the lower limbs and a slight rise of temperature. These symptoms last from one to two days but never more than four days and disappear without leaving any trace behind them; they are similar in nature and intensity to those which may follow an ordinary lumbar puncture.

Armour[3] states that he has noticed a distinct meningeal reaction in patients submitted to operation shortly after the injection of lipiodol. The meninges appeared thickened, somewhat reddened and agglutinated, while the cerebrospinal fluid was slightly turbid. He states that the following symptoms have been observed to follow a lipiodol injection: an increase in the root-pains at the site of the lesion lasting for some hours, general soreness and stiffness of the back muscles, headache, and a rise of temperature. Less commonly there has been increased difficulty in the act of micturition in cauda equina lesions. In one case, which eventually proved to be one of disseminated sclerosis, injection of lipiodol gave rise to pain on one side of the face, twitching of the left arm and leg with sensation of pins and needles in the left leg, which lasted for 24 hours.

Ebaugh and Mella[4] found that pains in the legs occurred in 30 per cent. of patients, rise of temperature in 23 per cent., nausea and headache in 7 per cent., leucocytosis in 30 per cent., pleocytosis in 60 per cent., and that sleeplessness and restlessness were ' frequent.' From the cellular increase in the cerebrospinal fluid, the increase in the protein content and the frequent presence of blood on lumbar puncture they concluded that lipiodol gave rise to an aseptic chemical meningitis.

Ayer and Mixter[5] in some experiments on animals found great cellular increase in the cerebrospinal fluid which reached its height in from 24 to 48 hours; counts of 1,000 cells with moderate increase in the protein content of the cerebrospinal fluid were noticed. Their results may, however, have been due to the use of a much larger quantity of lipiodol than is used in man.

Sharpe and Peterson[6] have reported a case where such an inflammatory reaction occurred from the arrested lipiodol at the site of the spinal block

that the patient's symptoms and signs were aggravated to a degree necessitating the removal of lipiodol five and a half months after its injection. The lipiodol was found as two encysted globules surrounded by numerous newly formed adhesions. McLaire[7] also reports a case of compression fracture with incompete transverse myelitis in which intraspinal damage was definitely increased by a lipiodol injection.

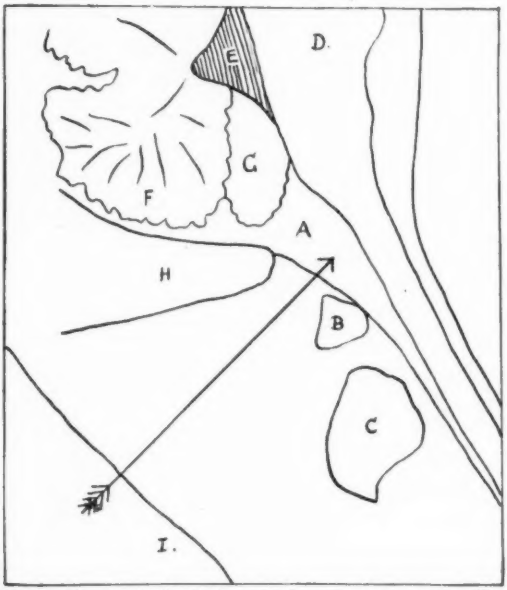

FIG. 1. Anatomical relations of the cisterna magna. The arrow indicates the position of the needle as it punctures the cistern.
A, cisterna magna; B, atlas; C, axis; D, pons; E, fourth ventricle; F, cerebellum; G, vermis; H, occipital bone; I, skin. (Diagram drawn from a photograph taken from Sicard and Forestier).

In the writer's series of cases, transient systemic and local symptoms, which rapidly disappeared, have been noted in a few cases. In some there was slight rise of temperature not exceeding 100° F. and lasting for a day or two. In two cases the rise of temperature was higher and more prolonged, but could be accounted for by a urinary infection already existent. Some patients complained of stiffness of the neck muscles and of headache, but these symptoms were not more severe than those following an ordinary lumbar puncture. In two cases there was definite increase of sphincter trouble and in one there was complete retention for several days following the injection.

TECHNIQUE OF CISTERNAL PUNCTURE.

The cisterna magna is the portion of the subarachnoid space which lies between the inferior surface of the cerebellum and the posterior surface of the medulla and in front of the occipitoatlantal ligament. It is a triangular space $1\frac{1}{2}$-$2\frac{1}{2}$ cms. deep, and the dura is therefore sufficiently distant from the medulla to allow a safe margin of play when making a cistern puncture (see fig. 1). The point of the needle reaches the occipitoatlantal ligament at a depth of 4-5 cm. in an adult of normal size. In obese patients or in muscular subjects with a thick neck the depth at which the cisterna magna lies from the surface may be greater and as much as 7 cm., while in children the space may be reached at a depth of less than 3 cm.

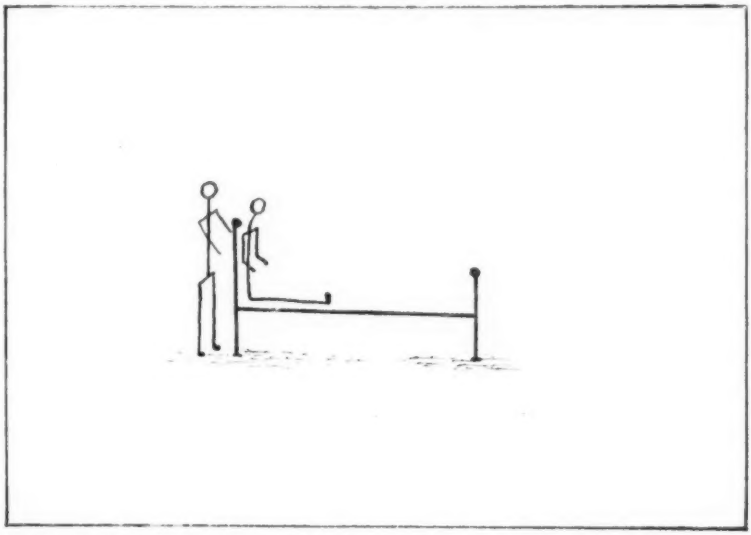

FIG. 2. Position of the operator and of the patient when performing a cistern puncture; the operator stands behind the bed while the patient is made to sit upright with his shoulders resting against the back of the bed and his head well flexed forwards.

The patient's hair should be shaved as high as the external occipital protuberance, and the skin of the neck sterilized. The patient should be sitting in bed or in a chair with his shoulders well supported by pillows and the neck flexed. If the patient cannot sit upright he may lie on his side with his head and shoulders slightly raised. The former position, however, is preferable and should be adopted whenever possible (see fig 2). A point is selected immediately above the axis process on the mid-line. The spinous process of the axis is easily felt in most cases and can be recognized without

difficulty as it is the first process to be felt (the first vertebra having none). The selected point is marked by injecting novocaine (2 per cent. solution) intradermally and forming a small bleb; the subcutaneous tissues are then infiltrated with novocaine down to a depth of 2-3 cm. After an interval of a few minutes to allow the anæsthesia to become complete, a lumbar puncture needle or a stout exploring needle 1 mm. in diameter and about 7 cm. long is fitted on to an ordinary Record syringe and is introduced through the

FIG. 3. *Faulty technique.* The needle was introduced too obliquely; consequently lipiodol was injected into the recess between the tonsils of the cerebellum, and was retained there by surface tension; the needle also slipped out of the cistern and lipiodol is seen infiltrating the soft tissues of the neck; two faults which must be avoided. No ill effects followed this injection but the cistern puncture had to be repeated.

selected point; the direction of the needle should be slightly upwards and in line with the external auditory meatus; care must be taken not to direct the needle too obliquely as in this case it may hit the occipital bone; or should it miss the occipital bone and enter the cistern, lipiodol may be injected into the recess between the tonsils of the cerebellum and in virtue of surface tension be retained there (see fig. 3). The needle can be introduced without fear for a depth of 3 cm., but thereafter must be pushed forward more cautiously; and its progress should be frequently checked by exhausting the syringe. As soon as the occipitoatlantal ligament is pierced

and the needle enters the cistern, cerebrospinal fluid will flow into the syringe. Once the needle has been correctly inserted it should be kept perfectly steady and great care should be taken to prevent it from slipping out; after withdrawing about 2 c.c. of cerebrospinal fluid, the syringe containing the lipiodol (which has been kept warm in a water bath) is gently attached to the needle and 1½-2 c.c. of lipiodol are slowly injected into the cistern. It is very difficult to predict the depth at which the cistern lies and therefore the use of a partially exhausted syringe is of great value in ascertaining whether or not the needle is correctly inserted into the cistern. It is not safe to rely on a spontaneous flow of cerebrospinal fluid through the needle, as, if the pressure happens to be too low, the flow may not occur in spite of the correct insertion of the needle. Sometimes the resistance felt by the operator on piercing the occipitoatlantal ligament may give the necessary information although the toughness of this ligament may vary considerably; in some cases the ligament is extremely hard to pierce while in other cases it may not offer any resistance at all.

The use of a good needle will make all the difference between a successful and an unsuccessful puncture and it is essential to use a very sharply pointed needle. The writer prefers to use an ordinary exploring needle with a short bevel and very sharp point. The needle should be about 7 cm. long and carry a mark 5 cm. from the point: an easy way of marking this point is to thread the needle through a small rubber disc cut from rubber tubing and to leave the disc at the required point. Lipiodol which is used for cistern puncture should be perfectly clear and transparent and free from air bubbles as these tend to hold up the lipiodol along the sides of the spinal canal. Only a small amount of cerebrospinal fluid (not more than 2 c.c.) should be drawn off in order to avoid collapsing the cisternal space by an excessive lowering of the pressure. For the same reason a lumbar puncture should not be made immediately before a cistern puncture.

Radiograms are taken shortly after the injection and when temporary block is suspected may have to be repeated in 24-48 hours' time. It is best to X-ray the patient in the upright position, but should the patient be unable to stand or to sit upright the couch on which he is lying can be tilted so as to have the shoulders well raised. It is inadvisable to X-ray him in the horizontal position as the normal curvature of the spine allows the oil to flow back and may thus give an erroneous impression of obstruction.

INTERPRETATION OF RESULTS.

Lipiodol which has been injected into the cisterna magna in the absence of any block passes straight down the spinal canal and falls into the dural cul-de-sac, where it can be seen at the level of the second sacral vertebra.

It collects there in the form of a large globule which varies in shape according to the position of the patient. If the patient has been X-rayed standing or sitting upright the globule will take the shape of a radish (see fig. 4), while if the radiogram has been taken with the patient in the prone position it will assume the shape of a rounded mass at the level of the third lumbar vertebra (see fig. 5).

FIG. 4. *No arrest.* Lipiodol injected into the cistern has fallen down to the lumbar cul-de-sac. Patient X-rayed in the upright position.

Sometimes a few drops of lipiodol may adhere to a nerve-root, or the lipiodol may move down slowly and be temporarily arrested, even when there may not be any actual cause for this. According to Laplane[8] this temporary arrest occurs most frequently between the seventh cervical and the fifth dorsal vertebræ; it may, however, in the writer's experience also occur between the eighth dorsal and the first lumbar vertebræ; at this level the spinal canal has to accommodate the lumbar enlargement and a number of nerve-roots forming the cauda equina, and so the spinal canal is narrower and lipiodol may easily be held up. Lipiodol adhering to nerve-roots takes the shape of small blobs or of exclamation marks, and as a rule this false arrest can be easily differentiated from true spinal block (see fig. 6).

I. *No arrest.*—The question of the reliability of negative findings (no arrest) has been raised. Can medullary compression be excluded when lipiodol passes straight down the subarachnoid space? Armour[3] states definitely that it cannot. He mentions a case on which he operated only three months after the onset of root-pains. Here the very small size of the tumour could not possibly have interfered with the descent of the lipiodol. Babinski[9] reported a case in which spinal compression was suspected and

FIG. 5. *No arrest.* The unusual rounded shape of the lipiodol shadow is due to the patient having been X-rayed in the prone position.

in which a first injection of lipiodol did not reveal any spinal block. A second injection two to three months afterwards demonstrated, instead, complete block, and at the operation an extramedullary tumour was found. On the other hand, De Martel[10] has reported four cases with lipiodol arrest for which he could not find any adequate reason at the time of operation. In two cases it appeared that the lipiodol arrest had been the only indication for an operation. Sicard though admitting that lipiodol block may be absent in some early cases of spinal tumour quite rightly argues that in such cases other methods of demonstrating spinal block would have failed likewise.

II. *Partial arrest.*—Lipiodol may partly be held up by an incomplete obstruction and some of the oil may be seen to trickle through the site of

obstruction and to fall down to the lumbar cul-de-sac. This may occur at the beginning of extradural or intradural compression and particularly in cases of intramedullary tumours. Whenever a partial obstruction is suspected the patient should be X-rayed again one or two days after the injection and sometimes after an interval of a week or more, and the progress

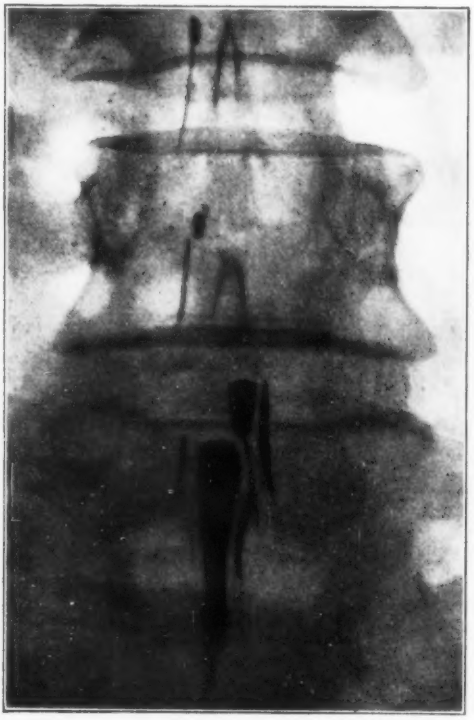

FIG. 6. *False arrest.* Some lipiodol is seen adhering to the nerve roots of the cauda equina. (Case of disseminated sclerosis).

of the oil checked along the spinal canal. Cases showing incomplete arrest often offer the greatest difficulty in diagnosis. In the case of intramedullary tumours the condition may sometimes be recognized by the shape of the lipiodol shadow, which outlines the fusiform enlargement of the cord in the form of narrow slips at either side of the cord. The same appearance may, however, be given by syringomyelia, as the following case shows.

Female, æt. 33. One year's history of pain in the right knee followed by stiffness of the right leg. Later she complained of stumbling and of frequent desire to micturate but without realization.

Examination showed spastic paraparesis with exaggerated deep reflexes, ankle clonus and bilateral extensor response. Some dissociated sensory loss of the syringomyelic type was present below the level of the knees. Lipiodol was partially held up in thin lateral slips at the level of the ninth thoracic vertebra. A laminectomy was performed and the cord exposed for a length of four inches. No tumour was found (see fig. 7).

FIG. 7. *Case of syringomyelia.* Partial arrest of lipiodol along the side of enlarged segments of the cord.

Partial arrest may also be due to adhesions between the dura and the cord or to discrete strands passing across the subarachnoid space. These adhesions and strands occur from many different causes; they may be traumatic, the result of contusion of the pia-arachnoid and of extravasation of blood at the site of a fracture-dislocation of the spine. In such cases lipiodol is held up not so much by pressure and obstruction caused by the

bony deformity as by the presence of adhesions, the oil being arrested in the form of large globules along a fairly large segment of the cord. Similar findings are found in cases of traumatic myelitis and of traumatic hæmatomyelia.

FIG. 8. *Case of traumatic hæmatomyelia.* Lipiodol has been partially arrested in the form of large droplets in the lower dorsal region. An x-ray of the spine did not show any sign of bone injury.

Male, æt. 53. Two days after having been knocked down by a motor car he suddenly became paralysed in both lower limbs.

Examination showed flaccid paraplegia with loss of deep reflexes and dissociated anæsthesia of syringomyelic type of both legs. The X-ray of the spine did not reveal any bony deformity. Lipiodol was arrested all along the lower dorsal cord (see fig. 8).

Meningeal adhesions may occur in extensive subacute or chronic forms of syphilitic meningitis and in tuberculous infections of the epidural space associated with an intravertebral abscess and with paraplegia. These cases, however, are usually easily diagnosed without the aid of a lipiodol examination as they present serological and radiological features which are sufficiently distinctive for a diagnosis to be made.

In the case of Pott's disease some interesting observations have been made by Mme. Sorel-Dejerine[11]; she noted that the arrest persisted as long as the paraplegia was stationary and that the lipiodol progressively fell as the compression regressed and the subarachnoid space became freer. On the other hand, there is a real diagnostic difficulty in differentiating spinal tumour from hypertrophic pachymeningitis, syringomyelia, and meningitis serosa circumscripta. The syringomyelic enlargement of the cord may so tightly fill the theca as partially or completely to obstruct the spinal flow of the cerebrospinal fluid and so give rise to partial or complete lipiodol arrest. Two cases of syringomyelia have been observed showing partial lipiodol arrest; in one case the lipiodol was held up along the side of the enlarged segments of the cord, while in the other it was partially held up transversely in the shape of a comb. The history of one case has already been given.

Male, æt. 43. Twelve years' history of progressive weakness and of wasting of both legs. In 1926 sores appeared on the right ankle and on the dorsum of the left foot which were quite painless. Wasting and loss of power of peronei, tibialis anticus and quadriceps. Dissociated anæsthesia. Loss of deep reflexes of lower limbs. Lipiodol was partially held up at the level of the first lumbar vertebra but in 18 hours it had all descended to the lumbar cul-de-sac. The patient four years after was reported to be much in the same condition as he was when discharged from hospital (see fig. 9).

Hypertrophic pachymeningitis may completely obliterate the subarachnoid space and so hold up the lipiodol in exactly the same manner as a spinal tumour which is causing complete obstruction. The following case is an interesting example of hypertrophic pachymeningitis with localized hydromyelia of the upper dorsal cord causing complete lipiodol arrest.

Female, æt, 23. Four years' history. Onset with typical root-pains across the lower abdomen and radiating down the front of the left thigh and knee. Subsequently she became paralysed in the left leg and after a short time also in the right one.

On examination there was an extreme degree of spastic paraplegia in flexion together with dissociated anæsthesia below the level of the fifth dorsal segment. Lipiodol was completely arrested at the level of the fourth thoracic vertebra (see fig. 10).

A laminectomy was performed and on dividing the dura the opening led straight into a cystic dilatation of the cord. The patient died soon after the operation. At autopsy the upper dorsal cord was found to be the site of a localized hydromyelia and of adhesive pachymeningitis completely obliterating the subarachnoid space.

In the case of meningitis serosa circumscripta lipiodol is held up by the presence of strands of translucent membrane passing across the subarachnoid space. The radiological appearance is often quite characteristic as the oil is held up in large droplets along a large segment of the cord and there is no clear cut line of arrest (see figs. 11 and 12).

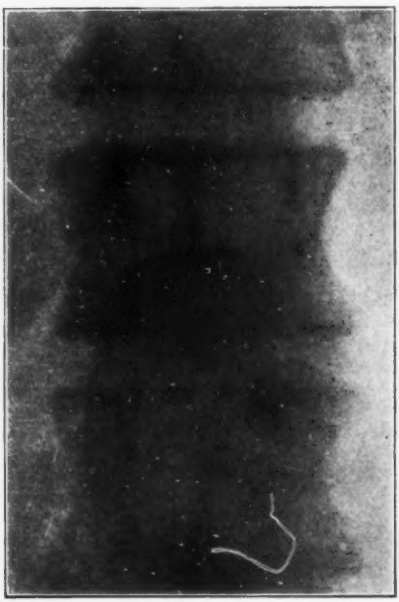

FIG. 9. *Case of syringomyelia.* Lipiodol has been partially arrested at the level of the first lumbar vertebra.

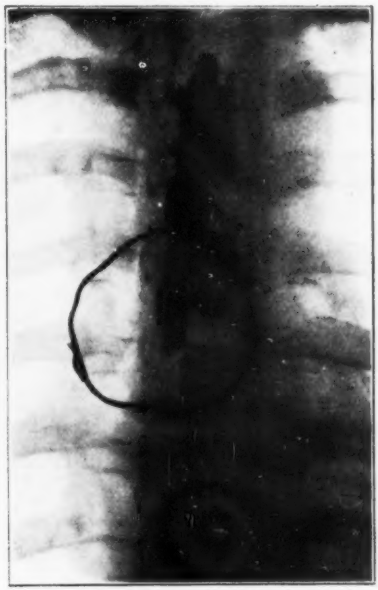

FIG. 10. *Case of pachymeningitis with hydromyelia.* Complete lipiodol arrest at the level of the fourth thoracic vertebra. Condition confirmed at autopsy.

The following are two such cases which have both been confirmed by operation.

Male, æt. 43. In March, 1930, while at work was seized by severe stabbing pain in the lower part of his back. In August, 1930, he complained of weakness of the right leg, which two months later was followed by weakness of the left leg.

Examination revealed a spastic paraplegia with sensory loss below the level of the first lumbar segment. Lipiodol injected into the cistern was arrested at the level of D6-8. In October, 1930, a laminectomy was performed and the cord exposed from the sixth to the tenth thoracic vertebra. The cord was found to be adherent to the dura by some fibrous adhesions but no tumour was found. The pain was somewhat relieved after the operation but the paraplegia remained unchanged. In March, 1931, another laminectomy was performed and this time the cord was exposed up to the fifth thoracic vertebra. The meninges were found

to be thickened to about three times their normal size. Lipiodol was released at the level of D6-8 (see fig. 11).

Male, æt. 26. At the age of 16 had an attack of cerebrospinal meningitis from which he apparently recovered completely. He went to Canada and worked on a farm. Five years ago he began to complain of pain in the right hip-joint and radiating down the front of the right thigh and leg. The pain was continuous and lasted for ten months and was followed by weakness and stiffness of the right leg. Two years ago the left leg became also affected.

FIG. 11. *Case of meningitis serosa circumscripta.* Lipiodol has been arrested in the form of large elongated droplets between the sixth and ninth thoracic vertebræ. Diagnosis confirmed by operation.

FIG. 12. *Case of meningitis serosa circumscripta.* Partial lipiodol arrest all along the dorsal and lumbar segments. Condition confirmed by operation.

On examination there was spastic paraplegia in flexion with exaggerated deep reflexes, knee and ankle clonus and a bilateral extensor response. The sensory loss was variable from day to day. Lipiodol was partially arrested at the level of the eleventh thoracic vertebra, and after 48 hours most of the oil had gravitated down to the bottom. A laminectomy revealed numerous adhesions between the dura and the cord (see fig. 12).

It is most unusual for osteoarthritis of the spine to cause compression of the cord. Some observers have reported cases in which this has occurred. Bailey and Casamajor[12] in 1911 published five cases of patients suffering from damage of the cord and its roots due to chronic inflammatory disease of the spine. Parker and Adson[13] in 1925 have also reported eight other cases. These authors maintain that in cases of osteoarthritis of the spine causing pressure symptoms the X-ray findings may be entirely negative as the overgrowth of bone in the early stages is soft and contains little calcium. In all their cases the condition was focal and confined to from one to four vertebræ. The symptoms and signs were similar to those of an extramedullary tumour but the pain produced was less spontaneous and more affected by posture, movement and exertion. Partial or complete spinal block was diagnosed in six of their cases by serological examinations, but in none of the cases was a lipiodol injection carried out. The following is a case of osteoarthritis of the spine with pressure symptoms and showing partial lipiodol arrest.

> Male, æt. 53. Seven months' history of pains in the groins shooting down the legs and of difficulty in walking. The patient presented a spastic paraplegia with increased deep reflexes, ankle clonus and a bilateral Babinski sign. There was also some sensory loss below the level of the eleventh dorsal segment. An X-ray of the spine showed marked osteoarthritis of the tenth and eleventh thoracic vertebræ with 'parrot-beaking.'
>
> Lipiodol was partially and temporarily held up at this level. A laminectomy was performed and the cord exposed between the tenth thoracic and the first lumbar vertebræ. Some extradural fat was present but no tumour was found.

Marked deviation of the spinal column does not usually cause pressure on the cord sufficient to hold up lipiodol, and if any obstruction be present some other cause should be suspected, such as spinal caries or a cancerous deposit. Of two cases with marked deformity of the spine in which a lipiodol examination was carried out, one did not show any lipiodol obstruction while the other showed some lipiodol arrest; in the latter, however, the patient had had a fall in childhood and the lipiodol arrest may have been due to the presence of meningeal adhesions.

III. *Complete arrest.*—This is characteristically seen in cases of spinal cord tumours. The shape of the lipiodol shadow at the site of the obstruction may vary. The lower border may be straight and horizontal, but it is more frequently irregular in shape, indented and somewhat ragged (see fig. 13), or may assume a typical crescentic or cupped appearance (see fig. 14). Sometimes lipiodol may be seen to encircle the tumour and to outline its shape, while a little of the oil may pass through and may be seen in the form of droplets below the level of the tumour. In other cases it may be held up for a considerable distance above the level of the obstruction by adhesions due to arachnoiditis accompanying the presence of a tumour. In cases of tumours involving the cauda equina lipiodol may be seen to infiltrate between

the matted nerve-roots and the shadow may take the shape of a comb with its teeth pointing downwards.

It is rarely possible to determine the nature of the tumour by the shape of the lipiodol shadow. Mixter[14] maintains that a cup or crescent, complete or incomplete, indicates an extramedullary tumour, while narrow lines at either side with an irregular mass above suggest a fusiform enlargement

FIG. 13. *Case of extramedullary tumour.* Complete lipiodol block at the level of the third thoracic vertebra. The lower border of the lipiodol shadow is irregular and indented; at the operation a cystic tumour the size of a pea was enucleated and the cord was found to be flattened underneath it.

FIG. 14. *Case of extramedullary tumour (dural endothelioma).* Complete lipiodol block at the level of the fifth thoracic vertebra with typical crescentic appearance. An ovoid tumour was successfully removed. The patient seen five years after the operation had completely recovered.

of the cord from an intramedullary tumour. This, however, has not been confirmed by other observers, and it is often quite impossible to form a definite opinion on the nature of the tumour from the lipiodol shadow alone. Nevertheless, a lipiodol examination has its definite field of usefulness as it provides a direct means of demonstrating spinal block and of accurately localizing the level of obstruction. The surgeon is given a definite level on which to centre a laminectomy, as the site of the lipiodol block nearly always corresponds accurately to the position of the tumour. In each of six cases of spinal tumour, which were all confirmed either by operation or at autopsy,

the lipiodol block accurately localized the position of the tumour, whereas there had been a tendency to localize the tumour neurologically below its actual level (see table). This may be explained by the fact that in early cases sensory changes may only be slight and the extreme upper limit of sensory loss may be ill-defined and lost; moreover even in cases presenting a complete or almost complete interruption of the cord the level of total anæsthesia is only a guide to the lowest segment which is completely interrupted and gives no indication of the vertical extent of the lesion (Armour).

TABLE.

Case	Lipiodol arrest (vertebra).	Neurological level (segment).
I	D5	D7
II	D8	D9
III	D3-4	D9
IV	D9	D10
V	D11	D9
VI	L5	S1

It will be seen from this table that if suitable allowance is made for the obliquity with which the afferent sensory fibres cross the cord and for the position of each segment of the cord with regard to its corresponding bony segment, the neurological localization in the above series of cases was fairly accurate. In one case, however, the tumour was localized neurologically below its actual level (Case III), while in another the level of sensory loss was above the level of spinal block (Case V).

CONCLUSIONS.

In conclusion it may be remarked that the injection of lipiodol into the cistern is a valuable adjunct to the diagnosis of spinal block. Although manometric and serological examinations of the cerebrospinal fluid may often give all the information which is required, a lipiodol examination provides additional and unequivocal evidence of spinal block, and is a means of accurately localizing the level of obstruction. A negative finding (no lipiodol arrest) can usually be taken as sufficient proof that there is no spinal block. Partial or even complete obstruction to the lipiodol flow may be brought about by conditions other than spinal tumour, and among the conditions which offer the greatest difficulty in the differential diagnosis are pachymeningitis, syringomyelia and meningitis serosa circumscripta. As a rule a lipiodol injection into the cisterna magna, if properly carried out, is a perfectly safe procedure and does not give rise to any marked or lasting symptoms of reaction. Caution, however, should be taken in inflammatory conditions of the cord and meninges, as in these cases the iodine component of lipiodol may have a congestive action and may lead to an aggravation of symptoms.

I wish to thank the physicians of the General Infirmary at Leeds for allowing me to refer to patients under their care.

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A PEDIGREE SHOWING AN ATYPICAL FORM OF HEREDITARY OPTIC ATROPHY EXHIBITING APPARENT POLYMORPHISM.

By

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INTRODUCTION.

Hereditary optic atrophy was first described and defined by Leber[1] in 1871 and since that date over two hundred pedigrees have been reported in detail. The condition is, of course, well-known and the clinical picture and inheritance appear to be remarkably constant.

The examples here described differ in various ways from the typical form; and a further interesting feature is the occurrence of retinitis pigmentosa in some members of the pedigree in an association that, as far as can be ascertained, has not been described before. It appears worth recording in that it suggests some kind of relation between the two conditions; and also there seem some grounds for supposing that this may be a form of hereditary optic atrophy distinct from that originally described by Leber.

It may be as well to summarize briefly, for comparison, the principal features of hereditary optic atrophy and retinitis pigmentosa.

Leber's atrophy is a heredofamilial disease, usually sex-limited, transmitted by the female and appearing in the male. The onset, sometimes with a preliminary phase of neuritis coming under observation, occasionally one eye preceding the other by some weeks, is most commonly at 24 years. There is considerable impairment of vision, non-progressive and occasionally improving slightly, usually a central scotoma for form and colour and, rarely, a peripheral contraction of the fields. Direct vision is the first to suffer, but it is not possible to say whether the degeneration is primarily in the papillomacular bundle or in the retinal ganglion-cell layer. One case only has been described post-mortem by Rehsteiner[2]. An atrophy of the retinal ganglion-cell layer with degeneration of the medullary sheaths and axis-cylinders of the optic nerve, most marked in the papillomacular bundle, was found. The author considers that the changes suggest a primary degeneration of the retina and optic nerve directly conditioned by the germ-plasm; he does not suggest which may have occurred first.

Retinitis pigmentosa presents a sharply contrasted picture. Although the symptoms alone allow of this, it was not until the invention of the

ophthalmoscope that the syndrome was delimited from congenital night-blindness: the main features are night-blindness, progressive contraction of the visual fields, and peripheral retinal pigmentation. Complete sex-limitation is less frequent than in hereditary optic atrophy, the age of onset is earlier, usually in childhood, and the condition is progressive, the disability increasing slowly to almost complete blindness at about 40 years. Many cases have been examined histologically; the changes found comprise an atrophy of the nervous elements of the retina, sclerosis of retinal vessels, hyperplasia of connective-tissue and a migration of pigment from the pigment-cell layer into the areas of atrophy. The original view that the changes are essentially inflammatory (De Wecker[3], etc.) is now no longer held, and it is thought that the process is degenerative, affecting, primarily, either the vessels or the nervous elements of the retina. Collins[4] regards the condition as abiotrophic, the process being one of a primary degeneration of the neuroepithelium followed by atrophy of nerve-fibres and increase of connective-tissue.

It appears, therefore, that while both may be regarded as primary degenerations of retinal and nervous elements, they are distinct in pathology and symptomatology.

DESCRIPTION OF PEDIGREE.

The H. family (Cases I 1, 2; II 1-9; III 1-5; IV 1, 2) has no history of eye trouble. Unfortunately it was not possible to see the surviving members, but the information obtained was fairly detailed; its members are of a higher social status than the rest of the pedigree and more closely in touch with each other, and the accounts obtained are probably reliable. It seems justifiable to exclude the occurrence of any eye condition in any way comparable to those shown in the rest of the pedigree. Cases II 4 and II 6 were twins, probably identical. The patient whose case is II 9 died in a mental hospital of ? mania; her eyes were normal.

Case II 10: E. W., has been dead for many years. He was an engine-driver and at about 45 years lost his job on account of colour-blindness; as this occurred when tests were first instituted on the railways, it does not necessarily represent the time of onset of the condition. He had no serious defect of vision, nor was he night-blind. It appears likely that this was a mild case of Leber's disease of the form exhibited by other members of the family, but of course the possibility that the defect was simply one of congenital colour-blindness cannot be excluded. He is said to have confused red and green and to have called blue white. His father is also thought to have been colour-blind and to have suffered with his eyes.

Case II 12: eyes reported normal.

Pedigree of the H. family, showing atypical hereditary optic atrophy and apparent polymorphism.

Case II 13: said to have been 'mental' and to have committed suicide.

Case II 14: died young of tuberculosis.

Case II 15: is said to have had bad sight and to have been colour-blind. It is probable that he suffered from optic atrophy.

Case II 17: W. W., 73 years, is the only surviving member of this generation; he is a sufferer from Paget's disease. There is no history of night-blindness, or defect in colour-vision; his eyesight began to fail at 50 years and has progressed until he can now only count fingers at 1 m. He has been almost completely deaf for many years.

On examination, the lenses are clear; both fundi show a large patch of pigmentation in the papillomacular region, which is superficial (retinal), and the edges are serrated. There is a fine superficial pigmentation extending 2 disc diameters around the disc, not well-marked, but more definite in the left eye. There is no peripheral pigmentation. The discs are well-coloured, the retinal vessels being perhaps rather small. This, of course, bears no resemblance to the picture of retinitis pigmentosa.

Case III 6: E. W., 55 years. His sight began to fail gradually, being noticeably bad at 18 years; night-blindness was the first prominent symptom. Later, constriction of the peripheral fields was complained of. The condition gradually progressed until now he can only detect hand movements. On examination his pupils are equal and react to light, nystagmoid jerks are present, there are extensive opacities of the posterior portion of the lens and there is typical and extensive peripheral retinal pigmentation with atrophy of the retinal vessels and of the greyish disc. The patient is very deaf. He is below the average in intelligence.

Case III 9: in Canada. She is said to have normal eyesight, and her children also are said to be normal.

Case III 10: C. W., 52 years. His sight was good at school, but gradually became affected, first noticeably so at 20 years. The symptoms complained of were night-blindness and difficulty with peripheral fields in the day-time. Upon examination, a refractive error was found in both eyes; pupils are equal and react to light, there is no nystagmus, both lenses show posterior opacities; there is extensive peripheral pigmentation of the retinitis pigmentosa type, while the disc is pale and the retinal vessels are narrow and atrophic. He can count fingers at 1 m. and is also very deaf. He is below the average in intelligence.

Cases III 12 and 13: died in infancy: cause unknown.

Case III 14: is a policeman. He and his family are normal.

Case III 16: is normal.

Case III 18: A. W., 38 years, had one depressive attack three years ago, lasting three months, during which he was in the Maudsley Hospital. He

became night-blind at 14 years, being unable to drive his father's cart home in the evenings. His sight gradually became worse until now he can distinguish hand movements only. His pupils are equal and react to light, there is a slight refractive error, and marked opacities in the posterior layer of both lenses. On examination, there are typical cortical cataracts in the right eye obscuring the disc, and very marked peripheral pigmentation; the discs are dirty grey and there is an atrophy of the retinal vessels. He is deaf, but this is not so marked as in the other cases. He is also below the average in intelligence.

Case III 21: is in Australia. She and her family are reported normal.

Cases III 22, 25, 26: they and their families are normal.

Case III 27: H. W., 50 years, has always had very bad eyes, but there has been no progression of his disability. He tried glasses at school and found them useless. He has always been known to be colour-blind. There is no night-blindness and he is not deaf. Upon examination, visual acuity is 2/60 in both eyes. The visual fields are normal, no central scotoma or constriction of the fields being found. He is practically completely colour-blind, recognizing only the deep red of the Edridge-Green lantern at 1 m. Both lenses are clear, the discs are very pale, not grey, cupped, with a well-marked lamina cribrosa. Vessels are not particularly contracted and there is no peripheral pigmentation. There are horizontal nystagmoid jerks of both eyes. He is an abnormal personality, and periodically deserts his family.

Cases III 29, 32 and 34: are normal. The last married an unrelated deaf-mute who deserted her.

Cases III 36-43: are normal.

Cases IV 3-6: are normal.

Cases IV 8 and 10: are normal.

Case IV 9: A.W., 18 years, is always known to have weak eyes, this being definitely remarked upon at the medical inspection when he started school. There is no night blindness. Upon examination, there is a slight refractive error, V.A.R. (corrected) 6/60, V.A.L. (corrected) 6/36. Lenses are clear, pupils react to light; there is definite optic atrophy, and slight disparity between the sizes of veins and arteries. There is no peripheral pigmentation, no scotoma and no constriction of visual fields. Colour-blindness is present, the patient being unable to read Ishihara's tables, but it is not so marked as in the other cases.

Case IV 14: is a difficult child and at times unmanageable at home. There is no mental defect.

Cases IV 15, 16, 17: are normal.

Cases IV 18-22: are normal.

Cases IV 23-27: are normal.

Case IV 28: is normal.

Case IV 29: E. W., 30 years, has always suffered from her eyes. Upon examination, visual acuity is 6/60 in both eyes, pupils are equal and react to light, lenses are clear, no peripheral pigmentation or constriction, no scotoma, no nystagmus. Both discs show optic atrophy, being very pale. Vessels are slightly constricted. She is very colour-blind, being unable to distinguish reds and greens on the Edridge-Green lantern at 1 m.

Case IV 30: L. W., 27 years, has always had bad eyes and a noticeable nystagmus. Two years ago she complained of giddiness and weakness of the left leg. The spinal fluid was normal. She was considered to be a case of disseminated sclerosis. A year ago she was admitted to the Maudsley Hospital. Upon examination, she showed a visual acuity of 6/36 in both eyes, pupils equal and active to light, lenses clear, pallor and definite atrophy of the discs, and retinal vessels slightly reduced in size. There was no peripheral pigmentation or contraction and no central scotoma. She was very colour-blind, finding great difficulty with blue and yellow at 1 m. with the Edridge-Green lantern. She showed a weakness of the left leg and stocking and glove anæsthesia on that side. These latter symptoms cleared up after some weeks in hospital, but her eye condition remained the same. She was considered to be a case of hereditary optic atrophy with additional symptoms of conversion hysteria.

Case IV 31: is normal.

Cases IV 32-57: are normal, except for Case IV 41 and Case IV 44 who have strabismus, and Case IV 53 who is a congenital mental defective.

In the fourth generation Cases IV 1, 2, 5, 6, 10, 14-17, 25, 26, 27, 28, 39-47, 49-57 are all under 15 years, so that it is not possible to exclude a subsequent development of retinitis pigmentosa with an onset comparable to the other cases.

There is no consanguinity. No marked over-indulgence in alcohol or tobacco was reported.

DISCUSSION.

The cases in the above pedigree, described as hereditary optic atrophy, while resembling each other very closely, differ from the typical example of the condition in their very early, probably congenital, onset, the absence of a central scotoma, the occurrence of transmission through the male and of the comparatively high female incidence. A consideration of the literature reveals that, though uncommon, none of these features are unknown. To quote Bell's[5] detailed analysis of the available literature, she finds that 5·5 per cent. of European cases show an onset up to 7 years of age; 11·9 per cent. males and 18 per cent. females show no central scotoma; in males 4 per cent. of cases show the father affected, ·9 per cent. the father's stock,

4·9 ± 0·6 per cent. transmission through the father; in females, father affected in 13·6 per cent, the father's stock 2·3 per cent., transmission through the father 15·9 ± 2·6 per cent.; 15·2 per cent. is the female sex incidence.

The question arises whether cases which show exceptional features have enough in common to permit of their separation into a group distinct from the ordinary cases of Leber's disease. It has been suggested that this may be true of cases showing a very early, or congenital, onset, such as those of Clemesha, Doynes, Jakobsohn, Gunn, Hutchinson, Posey and Snell. Snell's[6] case may be quoted in more detail as it shows various points in common with this pedigree.

The parents and grandparents were normal. Case III 1: 33 years, male, unaffected. Case III 2: female, 32 years, had R.V. = 3/36, L.V. = 3/60, discs pale, colour-sense feeble. Case III 3: male, 31 years, had good sight and normal fundi but was colour-blind, confusing dark green with red and pale blue with pink. Case III 4: male, 29 years; R.V. = L.V. = 8/200, discs white, vessels normal. Sight always the same; children normal. Case III 6: male, 27 years; R.V. = L.V. = 6/60 with −1 D. Discs pale, especially temporal half, colour-vision weak. Case III 7: female, 25 years, unaffected. Case III 8: male, 24 years; R.V. = L.V. = 6/60, discs pale, colour-sense defective. Case III 9: female, 21 years; R.V. = L.V. = 6/24 with −6 D. Discs pale, crescents noted, colour-sense normal. In all cases the condition has been present since earliest recollection, there was no scotoma and no peripheral contraction of the fields. This case has been referred to (Cargill[7]) as an example of an atypical variety of Leber's disease, but other cases of early onset do not appear to have any of its unusual features. Nettleship[8] saw no justification for regarding cases with congenital onset as a distinct group, and Bell[9], with a larger available literature, concurs with him.

In our pedigree the occurrence of three typical cases of retinitis pigmentosa is difficult to interpret. The only other reported pedigree in which this occurs is that of Mann[10]. Here, a brother and sister were found to show optic atrophy; no eye disease occurred in the grandparents, parents or siblings, but a maternal aunt had eight children of whom four had retinitis pigmentosa and four had changes in the fundus suggestive of this condition; but as it was found that the man she married came of a stock in which retinitis pigmentosa had occurred, it is evident that the association of the two conditions is apparent only.

The only possibility that in the family here described the association of Leber's disease and retinitis pigmentosa is in the same way a chance one, is that Case II 4 may have transmitted the retinitis pigmentosa into a stock showing Leber's atrophy. This appears most unlikely in that there is no history of the condition in the H. family; and the twin sister, Case II 6, had

many healthy descendants. Also it is possible that Case II 17 shows a condition definitely related to the cases in the family showing retinitis pigmentosa (Cases III 6, III 10, III 18). This is suggested by the occurrence of deafness in this case, a condition found elsewhere in the pedigree only in the examples showing the typical eye picture, as it is found that when one case of retinitis pigmentosa in a given pedigree is deaf, the correlation of the two in that particular pedigree is exceedingly high (as shown in Usher's pedigrees[10]). It does not, of course, follow because a patient with retinitis pigmentosa is deaf that any other deaf person in the family is necessarily also a case of retinitis pigmentosa; but in this particular case the association is interesting in view of the eye picture, and it tends to support the argument that retinitis pigmentosa was not introduced into the family through Case II 4.

In the literature there are various associations of optic atrophy and indefinite pigmentary changes. Coste[11] reports a family in which four males show optic atrophy while a brother of one of them shows pigmentary choroiditis, and in one of Usher's[12] cases in which there are seven males and one female with optic atrophy in three generations, there are uniocular pigmentary changes in two individuals, while one of them has in addition a black-pepper appearance at the yellow spot in both eyes. In families exhibiting retinitis pigmentosa the only ones in which other cases occurred suffering from optic atrophy are those of Usher[13] and Schmidt[14]. In both of these the condition was uniocular and confined to one individual. It seems justifiable to assume that in none of these cases is there any reason to consider that any relation is shown between hereditary optic atrophy and any case of definite retinal pigmentation.

Retinitis pigmentosa, although usually exhibiting a clear-cut picture, appears at times definitely related to other conditions. Polydactylism and glaucoma may be combined with it in the same way as deafness in particular families. The Laurence Biedl syndrome, of which the first example was recorded by Laurence and Moon[15] in 1866, in which polydactylism, atresia ani, mental defect, obesity with genital hypoplasia, are combined with an atypical retinitis pigmentosa is a familial condition which appears related. Retinitis pigmentosa sine pigmento, first described by Leber[16] in 1871 occurring in families showing the typical condition, is also a recognized variant; choroideræmia (see Smith and Usher's case[17]) appears to be closely allied. Retinitis punctata albescens, distinguished first by Mooren[18] in 1882, occurs most frequently in families showing retinitis pigmentosa, and once with atypical retinitis pigmentosa in a case described as an example of the Laurence Biedl syndrome (Lisser[19]). There is nothing to suggest, through these diseases, any indirect connexion between Leber's disease and retinitis pigmentosa.

Pedigrees of both hereditary optic atrophy and retinitis pigmentosa show frequently other defects. Epilepsy and mental defect are the commonest examples; some fifteen pedigrees with epilepsy and Leber's disease, five of epilepsy and retinitis pigmentosa, five of mental defect and Leber's disease, twenty-five of mental defect and retinitis pigmentosa have been reported. Other defects occurring with Leber's disease, but much less frequently, such as syndactylism, congenital night-blindness and albinism, occur also in pedigrees of retinitis pigmentosa. But whatever the explanation of the frequency of other defects in pedigrees showing the two conditions no conclusion as to any specific relationship between hereditary optic atrophy and retinitis pigmentosa can be drawn from this, as such defects are also of frequent occurrence in other hereditary diseases.

CONCLUSIONS.

While Leber originally defined this condition as a hereditary optic atrophy without other neurological signs, thus differentiating it from other varieties of nervous diseases in which optic atrophy is but one of many prominent symptoms, there are various intermediate forms in which, while optic atrophy is the distinctive feature, other definite neurological signs are present. The best known variety is that of Behr[20], described as complicated heredofamilial infantile optic atrophy, which shows in addition to optic atrophy, pyramidal and cerebellar signs, further cases of which have been recorded by Takashima[21], who established definitely the stationary character of the condition. Ferguson and Critchley[22] describe a case in which two of a sibship show typical Leber's atrophy, a third shows atrophy complicated by mental defect and epileptic attacks, while a fourth has optic atrophy, pyramidal disease, ataxia and sensory loss. In their discussion they suggest that it may be possible to trace a transition between the uncomplicated hereditary optic atrophy on the one hand to Marie's heredofamilial ataxia on the other, through Behr and Takashima's cases as the first stage; and Imamura and Ichikawa's[23] cases (those of a brother and sister with optic atrophy combined with weakness of the right face, poor convergence, and in the former nystagmus on lateral deviation, in the latter, tremor of the trunk, tongue and fingers, some rigidity of the limbs and incoordination of fine movements) and their own fourth case as the second stage. Their own pedigree is of particular interest in that not only is there a rare example of complicated hereditary optic atrophy, but that it occurs in the same sibship as two cases of typical Leber's atrophy, and may thus be regarded as a possible polymorphic variety of the latter condition. Whether this is so or not can only be determined by subsequent investigation of their descendants, as the previous family history is negative.

It appears possible that the case here recorded may also form one of a group of a distinct variety of optic atrophy and that this group may also represent a transition between Leber's hereditary optic atrophy and retinitis pigmentosa. Apart from the age of onset, the most striking anomalous feature is the manner of transmission. In considering the recorded examples of transmission through the male, while it is found that, in the majority, this occurs as an isolated instance in a pedigree exhibiting otherwise the normal inheritance, there are pedigrees in which it seems to be the rule, forming thus a striking contrast to the usual pedigree. The following are examples of this.

Griscom[24] records a family with eight affected males and six affected females in three generations comprising 16 males and 16 females. Four affected and one unaffected male transmit the condition and one affected female has two unaffected sons and one unaffected daughter. The other example of this in the literature is the case recorded by Yo-Kansyo[25] of ten affected males and two females in four generations; here five affected males transmit the condition and one affected female. On one occasion an affected male has a normal family, but it is stated that the latter is too young to be certain that some members of it may not show the condition later. It is noteworthy that in the former pedigree several members show, in addition to the optic atrophy, abnormal retinal pigmentation; a female, aged 34, had a complete narrow ring of choroidal atrophy surrounding the disc, the vessels were thread-like in size, the macula showed a fine pigment disturbance and in the periphery there were a few spicule-like pigment areas overlying the retinal vessels; a male, 32 years, had vessels about one-half normal size and fine granular pigmentation throughout the retina; a male, 30 years, had vessels almost thread-like in size, retinæ finely granular throughout and a few pin-point glistening spots and fine pigment deposits seen in the macular region. The recorder concludes that the pigment disturbance and atrophic vessels are evidence of a low-grade retinal degeneration resulting from nutritional disturbances from a toxæmia affecting the optic nerve and retina; but whatever the explanation of the local happenings it is the inheritance of the specific weakness of these structures that is of particular interest. Unfortunately, in Kawakami's abstract of Yo-Kansyo's case there is no detailed description of the fundi of the members of this pedigree.

In the pedigree recorded here it seems probable that the appearance of retinitis pigmentosa in one sibship is more than a chance association, for the reasons given above, and that it may be regarded as a polymorphic manifestation of Leber's disease occurring here, the sequence of Cases II 10, III 10, and IV 9 being particularly suggestive in this connexion; while the condition shown by Case II 17 may also possibly be related to the two conditions.

Here, therefore, are three pedigrees in which the manner of inheritance is absolutely different from that of other cases of Leber's optic atrophy: (1) in Yo-Kansyo's case male transmission is invariable except for one instance in which an affected female transmits the condition; (2) in Griscom's case male transmission is the rule and definite instances of retinal pigmentation occur; and (3) in the case here recorded, there is male transmission only, three cases of typical retinitis pigmentosa and one of atypical pigmentation. There seems, therefore, some justification for regarding these as a distinct group, possibly intermediate between Leber's hereditary optic atrophy and retinitis pigmentosa.

The rarity of examples of predominantly male transmission of any hereditary disease has rendered the factors responsible for this very obscure; at any rate no comparable cases appear to have been recorded in the literature of retinitis pigmentosa except possibly a type of case, represented by pedigrees of Nettleship[26] and Snell[27], in which the defect occurs with extreme frequency and is invariably transmitted by affected members, whether male or female.

SUMMARY.

This pedigree differs from that typical of Leber's hereditary atrophy in several respects. The defect is congenital, there is no central scotoma and females are affected. It is stated, on the best authority, that there is no reason for regarding cases of congenital onset as forming a group distinct from Leber's atrophy and there are certainly no other features common to the cases; in the present instance the only other pedigree resembling this one in these particulars is that of Snell.

In the pedigree there are three cases of typical retinitis pigmentosa and one case with retinal pigmentation in the region of the macula. While it is possible that the retinitis pigmentosa was introduced by marriage and that the fourth case is a coincidence, it seems on the whole unlikely and that there is a real connexion between these and the cases of optic atrophy.

The last point of importance is that in every case in the pedigree transmission is through the male. Whether, as has been suggested, it is justifiable to regard pedigrees with predominantly male transmission as forming a distinct group of hereditary optic atrophy, related on the one hand to Leber's atrophy and on the other to retinitis pigmentosa, in the same way as Behr's variety may be so regarded with its comparable relations, or not, this pedigree appears worthy of record on account of features which are of interest not only from the clinical aspect and with regard to the definition of Leber's disease, but also from the genetic point of view.

In conclusion, I wish to thank Mr. J. N. Tennent for examining Cases II 17, III 10, III 27, IV 9, and IV 29 with me and giving me the benefit of his opinion on them, and also to express my indebtedness to the monographs of Bell[5, 28] whose analysis of all available literature and her conclusions based upon them are invaluable when any new pedigree has to be considered. I also wish to thank Dr. Edward Mapother for kindly allowing me to use clinical material at the Maudsley Hospital.

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OCCULT LUMBOSACRAL MENINGOCELE.

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The mildest form of the congenital anomalies classed under the generic term of spina bifida is the occult variety, in connexion with which nothing may be visible externally beyond a small median fold or dimple; a tuft of hair is sometimes present, sometimes a small lipoma. The palpating finger may discover evidence of ununited laminæ and spinous processes. Through the gap no section of cord or membranes protrudes, but from the posterior aspect of the theca a fibrous band—the membrana reuniens—extends between the muscles to the under-surface of the skin at the dimple. Occasionally the back is entirely normal in appearance.

Should spinal meninges project through the laminal opening at all they are generally considered to reach the skin invariably, bulging it outwards to form a rounded sac constituting a meningocele. This of course is immediately visible, of varying size, sessile or pedunculated, translucent, and in part perhaps replaceable. Its contents comprise cerebrospinal fluid within a lining of arachnoid dura, but no neural tissue except possibly the incidental herniation of a spinal root.

The remarkable numerical preponderance of lower spine cases amid the total of all levels is apparent by a glance at the appended Table, derived from figures compiled by Stockmeyer[1].

TABLE.

Local incidence of spina bifida.

Region.	Number of cases.
Occipito-cervical	21
Thoracic	7
Lumbar	83
Lumbosacral	42
Sacral	60
	213

No fewer than 185 out of 213 cases involved the lumbar or sacral region, the percentage being just under 87.

In general, the occult lumbosacral variety gives rise to but few symptoms or signs; they are often unobtrusive, even latent; loss of knee- or ankle-jerks will escape notice unless looked for, and the solitary indication may possibly consist of a tendency to urinary incontinence. The condition is sometimes discovered by accident, as in the case of a patient of 40 who first complained of backache after a fall of a few feet.

The case here reported presents a series of unusual features, which may be summarized as follows: (1) complete absence of any exterior deformity or anomaly; (2) complete absence of symptoms till the age of 16; (3) excessive radicular and local pain when at length the condition manifested itself; (4) a pathological basis of what may fairly be termed occult meningocele, inasmuch as the cyst protruded beyond the laminal opening and burrowed under the erector spinæ muscles on each side.

PERSONAL CASE.

A. B., female, age 18, was admitted to hospital towards the close of 1930, with a complaint of pains and loss of power in the lower limbs.

The girl had always been healthy and active; and during both infancy and childhood no abnormality of lower limbs or sphincters was noticed. Some two years prior to her coming under observation a moderate attack of what was diagnosed as sciatica (on the right side) drew attention for the first time to that part of her body. After treatment prosecuted for some weeks the pain subsided. About a year later the pain returned, and thereafter did not disappear though its intensity fluctuated. Gradually during the last months before admission it became more and more severe, and at the same time the legs became weak, especially the right, and were considered by her mother to be getting thinner. Trouble with bladder and rectal control also made its appearance.

On admission, the girl was ascertained to be incapable of walking; her legs were drawn up at knee and hip, and were undoubtedly both wasted and flabby. Complete abolition of the deep reflexes in the lower limbs was noted. The plantar responses were practically nil. Incontinence or retention was present in regard to the bladder and rectum.

By far the most striking symptom, however, was the pain. The patient had become hysterical with suffering, and objective examination was conducted under wellnigh incredible difficulties. She screamed as soon as the bedclothes were removed for purposes of investigation; handling or palpating her spine and back was a frank impossibility. The pain was declared to be excruciating; it started over the sacrum or a little higher and radiated down both legs, especially the right. It was practically continuous, with paroxysmal exacerbations on movement, and in particular on coughing or sneezing. Objective sensory testing became farcical; yet so far as could be ascertained there was either diminution or loss to pin-prick over the lower sacral roots (S 2, 3, 4, 5) on both sides.

A decision was accordingly reached that further studies should be conducted under an anæsthetic. In this way the X-ray photographs were taken, and they disclosed the existence of a large and almost circular defect of bone-formation on the back of the sacrum, involving the lowest lumbar and the first sacral vertebræ (fig. 1). Its median position and symmetrical character were very striking and informative, pointing as they did to a spina bifida occulta lumbosacralis.

In view of this development in the case, the precise nature of which had not till then been apparent (the skin over the back was smooth and without blemish, though minute palpation of the spine had been rendered impossible owing to the patient's reactions), an operation was proposed and accepted.

FIG. 1 Skiagram of lumbosacral region, showing the circular defect in the last lumbar and first sacral vertebræ. There is complete absence of the laminæ and spinous processes.

Operation.—Under intratracheal ether and with the patient lying prone the lower lumbar and upper sacral region was exposed. The muscular masses of the erectores spinæ were retracted on either side of the spine. There was no sign of either laminæ or spinous processes of the last lumbar vertebra, and the posterior neural arch of the first sacral vertebra (segment) was absent. Through the bony defect the dura mater bulged so tensely as to appear as though it might burst; it extended beyond the osseous margins and burrowed on each side

under the erector spinæ (fig. 2). It thus constituted in point of fact an occult meningocele.

On incision into the bulging cyst a large quantity of spinal fluid escaped. The edges of the dura mater were retracted, and the roots of the cauda equina could be seen flattened against the lateral walls of the meningocele (fig. 3). There was no obstruction above or below the meningocele, which was carefully examined. Except for this flattening of roots no abnormality otherwise was

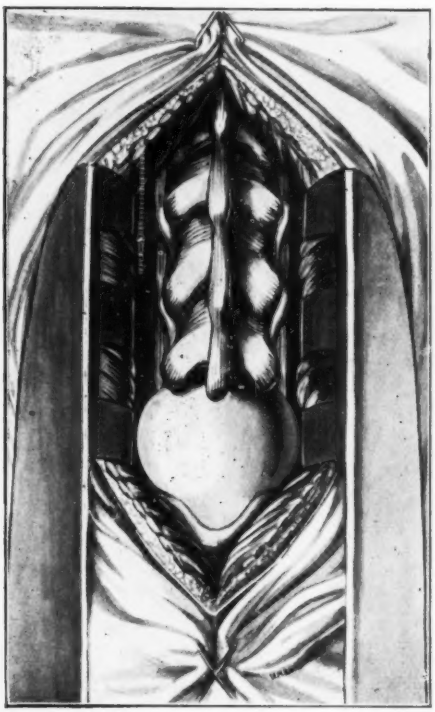

FIG. 2. Drawing, showing the tense and bulging meningocelic dura mater after the erector spinæ muscles had been retracted.

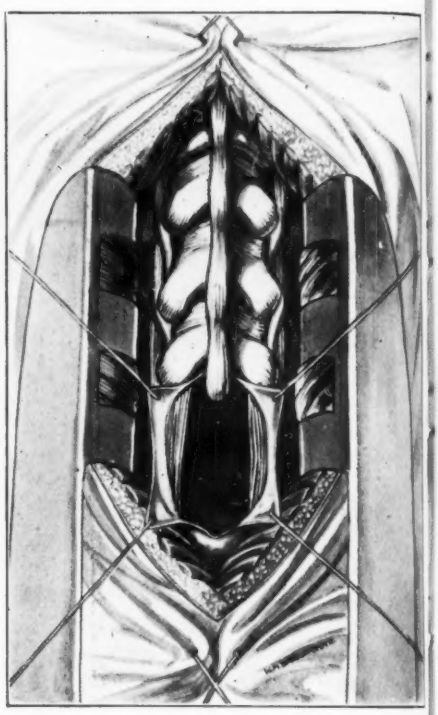

FIG. 3. Drawing, illustrating the marked flattening of the roots of the cauda equina. They were pressed up against the lateral walls of the bulging dural sac.

discovered. The redundant dura mater was cut away, and the edges of the membrane approximated except at the lower part: here the meninx was stitched to the erector spinæ muscle on each side in order to form a drain for any excess of spinal fluid. The latter muscles were stitched together in the midline and the skin wound closed with interrupted silkworm sutures. A small drain was inserted under the skin and removed after 24 hours.

The patient was nursed prone for the first week after the operation, and then alternatively on her side. The wound healed soundly, and the stitches were removed on the ninth day.

The relief from pain was immense; bladder control became more nearly normal, and further examination was made easy. This substantiated the hypalgesia or analgesia of the lower sacral root segments.

Treatment to the wasted legs became practicable, and the improvement was so rapid that the patient left hospital able to walk, some two months after her admission.

COMMENTARY.

Had the girl not been so hysterical over her pain it would no doubt have been possible to detect the ununited laminæ in the lumbosacral region, which seemed to be somewhat fuller and more rounded than usual. Yet the complete absence of any local malformation or congenital anomaly was at once manifest to the eye.

Occult lumbosacral meningocele of this kind is of interest more especially from the standpoint of its late evolution when all symptoms are in abeyance during the earlier years of life. To what factors this not infrequently observed succession of events is due has been much debated. The theory of Katzenstein[2] and others is that vertebral elongation during normal growth combines with anchorage of the hernia at the site of the lesion to cause progressive stretching and degeneration of spinal or radicular tissues, but it is not applicable to all cases—perhaps only to a minority. In this particular case the problem is to account for the gradual development in the late 'teens of a meningocele hidden under muscles, through a *congenital* aperture in the lumbosacral spine. No history of trauma was forthcoming; nor was there the slightest indication of any state of internal hydrocephalus such as might conceivably have hastened the bulging at the other end of the fluid system. The pathogenesis remains obscure, and no light is thrown thereon by reference to other cases of spina bifida occulta in which onset of symptoms occurred late. In one recorded by Hassin[3] they commenced at 36, in Marie and Léri's[4] at 46, in Bassoe's[5] at 52.

The occurrence of severe radicular neuralgia in the same condition is also distinctly rare; it is mentioned, however, by Margulis[6], Roederer and Lagrot[7], Beck[8], and others.

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Short Notes and Clinical Cases.

THE QUESTION OF SILVER CELLS AS PROOF OF THE SPIROCHÆTAL THEORY OF DISSEMINATED SCLEROSIS.*

By

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Since researches into the *Spherula insularis* theory of disseminated sclerosis have failed to furnish support for it, it was natural to turn to another prevalent view of the etiology of that disease, viz., that based on the work of Kuhn and Steiner, whose theory concerns a spirochætal origin.

Steiner in a recent monograph (1931) elaborated all his former work and devised a much simpler silver stain than he had formerly used. Among 28 cases of disseminated sclerosis he demonstrated a spirochæte in seven; this spirochæte did not resemble the *spirochæta pallida* of progressive paralysis, as it was much thicker and coarser. As further proof of his spirochætal theory he demonstrated ' silver cells ' in 26 of his 28 cases and these silver cells he found also in every case of progressive paralysis examined, but never once in over 100 control brains.

During the last nine months I have examined very carefully 11 cases of disseminated sclerosis with the Steiner silver method; up to the present I can only say definitely that in one case I have found an organism similar to the Steiner organism. But in every case I have found the silver cells and also in many cases a histological picture resembling spirochætal fragments. At all events the slides I have obtained are identical with those that Steiner pictures in his monograph.

To be certain that the technique was correct, following Steiner's advice I experimented for a long time on progressive paralysis brains, and then controlled the disseminated sclerosis cases in each instance with progressive paralysis cases; in each progressive paralysis control slide the *spirochæta pallida* was quickly recognized as well as the silver cells.

* Based on a paper read at the joint Neurological-Psychiatric Meeting held in Vienna, June 14th, 1932.

I have also very carefully examined the brains from four other disease-conditions, viz., cerebral softening, myotonia congenita, bulbar paralysis, and diffuse brain sclerosis; and in no case have I been able to demonstrate either spirochætes or silver cells.

We can, therefore, definitely state that to a certain degree the anatomico-pathological changes are similar in these two diseases, so far as the appearance of silver cells is concerned.

As to the spirochæte itself, I wish to be most cautious and only say now that the question of its possible etiological significance must be left aside until it can be demonstrated in more cases and with less difficulty than at present. However, we owe much to Steiner for his silver method; any one who is interested can undertake study of the subject in a large number of cases until we come to determine exactly what is correct and what is false.

As to the significance of the silver cells—this is, of course, a very difficult question. Definitely, they have nothing to do with fat-cells, as fat-cells take no silver stain. Also definitely, they are identical with those seen in progressive paralysis, and in both instances are perivascular in position.

Many authors have commented on a possible luetic factor appearing frequently in the histories of typical disseminated sclerosis cases, and it is natural, perhaps, to think of the possibility of that disease having a luetic antecedent. However, that is purely conjectural; and theories should not be advanced until a great number of brains have been repeatedly examined and further researches make us sure of our ground.

This is a preliminary report offered in the hope that it will stimulate further research along the same lines.

My work has been done in the Neurological Institute of the University of Vienna, under the expert and kindly guidance of Professor Otto Marburg and with the able assistance of Doctor Pfleger, to both of whom I am very grateful.

Critical Review.

THEORETICAL DEDUCTIONS FROM THE PHYSIOLOGY OF THE CEREBRAL CORTEX.

By

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It is now five years since the complete work of Professor Ivan Pavlov on 'conditioned reflexes' first made its appearance in English[1] and in that time a second volume[2] has also been published. The far-reaching importance of this original contribution to the physiology of cerebral function cannot be overestimated. Nevertheless, the difficulties inherent in the method and the time and patience required for its performance have resulted in the limitation of first-hand experience to comparatively few workers, with corresponding lack of discussion of the hypotheses which have been put forward to correlate the results of the work. Already writers on cerebral function have attempted to apply the hypotheses of Pavlov to the elucidation of their problems. Therefore it may not be out of place now to review some of these hypotheses. The space of time elapsed since their appearance precludes any such comment from being prejudicial to the reception of Pavlov's work in this country.

In common with many other well-studied nervous phenomena the conditioned reflexes are still obscure in their essential nature; the following discussion of them indicates a fresh point of view of cortical function.

THE MEANING OF 'REFLEX.'

The word 'reflex' has long had a specialized meaning, denoting automatic fixed inborn responses of the decerebrate nervous system to stimulation of sensory channels. Although, indeed, used by some to describe certain reactions obtained from the intact animal, the word reflex has come to imply assumed identity with the unwilled automatic response obtainable from subcortical nervous structure. In that reflex salivation can be obtained from a decerebrate animal by contact of food with the lining of the mouth, salivation may be reflex. The association of such salivation in response to a stimulus which requires the function of the cerebral cortex for its effect does not necessarily mean that it is then also reflex. Indeed, it is possibly in nature very different from true reflex salivation. The very inflexibility of

spinal, bulbar and subcortical reflexes is implicit in, and a necessary consequence of, anatomically prearranged fixed nervous channels; but the flexibility of ' conditioned reflexes ' points to quite a different mechanism. Flexibility of response to the same stimuli, and habituation to stimuli, appear to be two of the chief characteristics of *cerebral* nervous function. To identify *them* with the above *fixed* responses is to commence by confusing one of the issues of the enquiry.

It is possible that the fixed inborn response may be totally suppressed and replaced by a ' voluntary ' or other cortical response. So long as this possibility cannot be eliminated, the identity of one with the other, apart from their final common path, remains a matter for conjecture. The application of the word ' reflex ' is best retained for reactions from subcortical levels. The dividing line between conditioned response and reasoned response is vague enough. Pavlov defends his use of the word ' reflex ' by emphasising that the reactions of the animal could be described on a physiological basis without postulating motivation. By this bold stroke he establishes an objective approach to his problem. But such use of the word tends to bias the interpretation of the reactions in favour of fixed invariable responses, or to leave the word ' reflex ' with no meaning whatever, except response to stimulus. The use of the word by Pavlov to describe the reaction of the dog to the presence of something strange (' investigatory reflex ') or to conditions of ' restraint ' (' freedom reflex ') or to command (' reflex of slavery '), tends to have the result that each and every movement of an animal is to be called a reflex. Only some of the types of response called ' investigatory reflex '—for example, the investigatory reflex to light (ref. 1, p. 341) and the general auditory reflex to sound (p. 331)—can be obtained from the decorticate animal. The term ' conditioned *response* ' will, therefore, be used hereafter in this discussion instead of, and as equivalent to, Pavlov's term ' conditioned reflex.'

THE MECHANISM OF FIXATION OF CONDITIONED RESPONSES.

The essential feature of a conditioned response appears to be the relationship in time between a signal and response-exciting agent (usually a food agent and a corresponding alimentary response). The signal may involve the use of almost any afferent channel of the nervous system, and is a change of environment acquiring its value as a signal simply by virtue of its time relation to the exciting agent. The question of time is important, ' priority ' giving the association effect, and immediate priority being more potent than more remote.

For the establishment of the conditional response *satisfaction* of the nervous state set up is essential. The animal must be satisfied with food after repetition of the signal before the establishment of the signal as a reflex

stimulus can occur. What does this satisfaction or fulfilment of the train of events mean? Pavlov does not discuss this, although the psychologists have in their field encountered a similar problem for which, in a wider sense, Troland[3] proposes the term ' retroflex action,' and it is discussed by Lashley[4] in relation to experiments on learning without, however, any conclusion as to the means by which ' closure ' (completion of response) determines retention of habit. To the present writer the importance of fulfilment of the train of events in establishing a conditioned reflex or a habit illustrates a characteristic of cortical processes, and implies a definite kind of mechanism. The last step in the train of events must be the final proprioceptive sensory information reaching the cortex, implying repletion of the hunger need. Hunger, the approach of food indicated by a signal, and the proprioceptive information of fulfilment are the essentials for establishment of the signal-salivation-conditioned response association.

In confirmation of the importance of proprioceptive fulfilment information in cortical processes one may cite the uselessness of the deafferented arm in the monkey as originally demonstrated by Mott and Sherrington[5] and again more recently in greater detail in experiments by Sherrington[6] with the writer. Voluntary movement is a poor affair when lacking a running proprioceptive comment, and clinically, in cases of damage to the parietal cerebral cortex, it is obvious that though muscles may be contracted voluntarily, purposive movements are only very gross. Proprioception is in some way essential to cortical function apart from co-ordination of the final motor effect. The conditioned response, in the author's opinion, exemplifies that association. Not only is the information of final fulfilment necessary, but a running commentary, similar to the ' schema ' of Head and Holmes[7], on the course of the response as well. This is very evident in motor responses, and it should be possible to test in the alimentary conditioned response by appropriate desensitization of tracts of the alimentary canal before attempting the establishment of conditioned responses.

The conditioned response may be described as part of a hunger-signal-fulfilment sequence of events, where repetition gives some relative fixity to the sequence. This fixity is reflected in the occurrence of a temporary signal-to-preliminary-fulfilment association, the true conditioned response. Upon the variations of this response under various conditions the arguments of Pavlov develop. It is pertinent to enquire as deeply as we can into evidence for these objective phenomena based on cortical processes, and especially to define as closely as possible the functions thereby deduced, at the same time being alert against the besetting tendency to identify the processes with those known in spinal reflexes on the one hand and with psychological conceptions on the other. Too close identification at the outset may only hinder the more rapid progress enabled by a wider, less committal view.

ATTENTION AND DISTRACTION.

The elaborate precautions to isolate the stimulus from other changes of environment by the experimenter with conditioned reflexes illustrate the absolute necessity for avoiding interruption of the experiment. For instance, any extraneous stimulus, a noise or other sensation, concurrent with the stimulus which has been conditioned, interferes with the experiment, and no response may occur. The response is prevented by the extraneous stimulus. There is, however, no evidence that it is *actively* prevented. To use the word 'inhibit' ('external inhibition') in this sense seems inadvisable. Inhibition in spinal reflexes is an *active* negative process, an active prevention of excitation, and is set up and persists just as does its corresponding opposite, excitation. Many years of careful work have established the existence of true reflex inhibition. To apply the word to any and every state of affairs where a nervous response fails to occur impedes analysis and is open to confusion.

The reason for the non-occurrence of the conditioned response when an extraneous stimulus interferes with the working of the conditioned signal may possibly be true inhibition; but there is nothing to show that it is not mere passive absence of response.

There is abundant objective evidence that cortical reaction at any one moment is a peak of activity in an otherwise dormant field. In everyday language, attention cannot be divided without impairment of function. To regard interruption of a conditioned reflex by a new, unusual, and therefore functionally more appealing stimulus as a transfer of attention requires no recourse to subjective argument. To a physiologist attention means a concentration of cortical processes upon the most sudden (and least adapted) change in the information from the environment. May it not be that the process which underlies cerebral focus or concentration is, for instance, a reflex link which, by virtue of a strangeness or newness in the environment, is added to otherwise incomplete nervous circuits to allow the easier passage of impulses over the pathways connected to the temporarily most appropriate receptor? For instance, a strange noise will temporarily focus nervous function on hearing to the detriment of visual discrimination. Such a supernumerary labile linkage could not have been considered a few years ago, but the modern hypothesis of subliminal processes in the spinal reflexes[8] absorbs it without difficulty. Additional subliminal excitation added at any point can, by facilitation, lower the threshold for all reflexes reaching that point, and enable them to produce an effect which otherwise they could not produce. Such an explanation has the merit of being a positive one, for on analogy with the processes of spinal reflexes, it requires only that this or that moiety of the cortex is 'facilitated' by a positive excitation. It necessitates a locus where newness of stimulus can be appreciated, and a

mechanism whereby the appropriate area of cortex can be lowered in threshold, but we shall see below that such a mechanism may also have a use in other cortical processes, notably in the explanation of sleep.

The process of distraction of a conditioned response therefore becomes a possibility as a purely positive process. A conditioned response is a positive activity; its abeyance may imply merely a shift of the activity elsewhere, and not necessarily a negative, active suppression. The position is clearer perhaps when several conditioned reflexes are interacting. Here it seems simpler and more sound to consider first whether the resultant response be merely the effect of the signal which for purely biological reasons most claims attention, slightly altered maybe by the distracting effect of the others upon the singleness of the attention, rather than to consider possible supposed mutual counterinhibitions interacting and spreading ov a cortical receiving mechanism. It may be objected that such a superadde subsidising mechanism, or attentive process, adds to the complication of the supposed mechanism, but Pavlov has to use the ' investigatory reflex ' to provide his ' external inhibition,' and its important effects require closer analysis. It seems better here to leave interpretation mor open and to call the process ' external inhibition ' simply ' extern distraction ' or ' external interruption.' The process of ' attention ' he outlined would appear identical with that described as ' investigatory reflex by Pavlov, except that ' attention ' is assumed to take part in every conditioned response.

When a conditioned response has once been established it reaches a maximum and then gradually fades, so that in time the stimulus produces no effect, even if it be ' reinforced ' regularly[9], and may even becom ' inhibitory.' Such fading is regarded by Pavlov as ' functional exhaustio of the nerve-cells, but not ' autodestruction of the nerve-cells ' because refl inhibition can still be produced by the stimulus. A weakening of the attentive facilitative process would seem here also to give a more satisfactory explanation than that the conditioned response ' develops inhibition,' a negativity which is itself unexplained.

Pavlov finds that a long interval between the signal and the conditioned response, the ' trace reflex,' develops a certain property whereby any other conditioned reflex is depressed or even does not occur during that interval. He supposes that the time interval has ' inhibited ' other reflexes. But is this so? It seems obvious that the cerebral cortex is in some way estimating time during the interval. If food has been presented always thirty seconds after the signal then in some way salivation occurs thirty seconds after the signal only because the cortex has in some way been functioning to estimate that time. Here again, without necessarily invoking the activity of mind, there seems to be no real objection to supposing that attention is focussed

on bodily happenings such as respiration, and the threshold raised for all other conditioned responses because they cannot gain attention. This process could be called an ' internal distraction,' distinct from ' inhibition.' After-effect of such a process reflects the after-effect of the activity underlying it, and is neither for nor against the presence of inhibition.

INHIBITION.

When a positive conditioned response has been established to one signal, and then another signal repeatedly presented without food (' unreinforced '), this second acquires negative properties. The positive response may be depressed if the positive signal is given just after the negative one. In this case the negative process is rightly called inhibitory, for it exerts actively a suppression of the positive response; and it can suppress other positive responses as well. The evidence, however, indicates that such a negative ' differential inhibition ' is not a simple corresponding opposite to the positive conditioned reflex. It is in fact a compound with the positive reflex, and we may suppose that the negative signal has the significance of the words ' not the positive signal.' To endow *implied negation* with signal value is surely not unphysiological when the receptive organ is one which is adapted for discrimination. The earlier establishment of the positive response is essential; that subsequent negative value is in some way bound to the positive response is illustrated by the way in which a slight external distraction produces once again the earlier positive response, a phenomenon called ' disinhibition '[10]. If we suppose the negative superstructure, being always a later addition to the positive response, to require for its effect even more facilitation by attention than does the original positive response, it becomes clear that even a slight distraction can allow a positive response to the negative stimulus. A strong distraction abolishes both reactions. It is absence of proprioceptive repercussion, together with relative likeness to a previously positive signal, which gives the negative signal its value. If there be already more than one established positive signal then an unreinforced signal implies negation of them all and must be engrafted upon each of the conditioned responses. It becomes inhibitory for them all.

If a signal be often enough repeated without the presentation of the food for which it was conditioned, if in Pavlov's words it be often enough ' unreinforced,' then the conditioned response fades, and eventually becomes ' conditioned inhibition ' and the reflex is considered subjected to ' extinction.' Pavlov argues that the process of extinction is not simply fatigue because the response is diminished beyond zero, as measured by the repetitions with reinforcement necessary for recovery. Rupture of anatomical connexions does not take place because the conditioned response will in time recover. He concludes, therefore, that the stimulus becomes ' inhibitory.'

The signal meaning must, however, be here considered, and a reasonable presumption seems to be that, since the whole process depends on an association of two things in time, a recent association of one thing with the *lack* of a habitual accompaniment must have as much significance as a signal as would its previous association. On this view extinction would be the development of a fresh conditioned response, in this case an active negation, a true inhibitory suppression response, a superstructure to the originally excitatory stimulus. Such experimental inhibitory extinction will in fact recover in time its original positive properties spontaneously, thus revealing the underlying positive process.

THE 'IRRADIATION' OF CORTICAL PROCESSES.

Objective investigation of the capacities of the sense-organs of the dog has advanced much by means of the determination of the least differences of sensation which can develop conditioned responses. How is this differentiation between stimuli carried out? A conditioned response when first established is 'generalized,' i.e., a wide group of somewhat similar stimuli all tend to give the same response. The explanation of generalization offered by Pavlov is a spread of excitation in the cortex. His evidence shows that the positive conditioning response has become associated with this wide group of sensory units. The 'spread of excitation,' however, must not here be taken too literally, for it is only the potentially positive *linkage* which has spread, and not the positive excitatory process itself. Indeed, the writer prefers to interpret the phenomenon of generalization as evidence that the establishment of a positive conditioned response is made only to the *general* properties of the signal until a negative stimulus is conditioned to eliminate such general properties. For example, a tone of so many vibrations a second at first evokes a response which appears to any similar tone signal. As soon as another stimulus is given a different significance 'differentiation' begins, and the stimuli are active in virtue of their more *specific* properties. Only stimuli which share uncontrasted properties are now excitants of the reflex. Pavlov calls this 'concentration' of the reflex. In whatever way one may regard this phenomenon it would appear that the cortex does not differentiate finely unless a contrast be offered. The curious mirroring of the signal area from one side of the body to the other found by Anrep[11] is striking evidence of the generalization of stimulus property. A stimulus from a body point on one side establishes signal value for the same point of the opposite side, until right is differentiated from left. The first tendency of the conditioned response is to make no differentiation, and very close differentiations are most easily made by gradual reduction of contrast. Contrast aids differentiation.

With highly commendable foresight, Pavlov named the receptive side of the conditioned response mechanism the 'analyser,' thus removing all

implication of anatomical nature from the discussion of sensory functional effects. He speaks of the visual, auditory, tactile and visual analysers as primary divisions of a sensory field. Thus generalization of a stimulus is spoken of as the ' irradiation ' of the effect of one particular stimulus to stimuli with related physical properties. In this way tones from similar regions of the scale, or skin points lying close to one another, become potentially endowed with the same effect. It is very necessary to consider in detail just how this ' spread ' of effect may occur.

Pavlov supposes that when a certain stimulus reaching an analyser becomes endowed with negative effect in virtue of its relationship to another established negative stimulus, inhibition has spread from the central representative of the one stimulus to that of the other. Inhibition and excitation can, he says, irradiate and concentrate in the analysers. In the sense that the conditioned effect of a stimulus depends on its relation to the effects of similar (therefore nearby) stimuli, inhibitory or excitatory effects may thus be said to be spread in the analyser. It must be pointed out, however, that by analyser Pavlov has defined the central sensorium as a functional plane not to be construed as meaning an anatomical structure, and by ' irradiation ' he is construing a widening of response significance in this functional plane. To apply the working of this conception to a layer of cortical nerve-cells is not by any means justified. The inhibition which ' irradiates,' irradiates in the *effects produced* by analyser mechanism, and to argue that inhibition spreads in the analyser structure itself is without further evidence unjustifiable. To extend the analogy further and speak of ' . . . internal inhibition which is widely irradiated, extending over the whole mass of the hemispheres and involving the lower centres of the brain as well '[12] is not only using the analyser and irradiation within it in a manner which the original definition aims to avoid, but is giving an anatomical basis to properties (such as linear relationship of tone series) which were allowed merely as properties of the analyser because its mechanism was purely functionally considered.

That inhibitory significance spreads from one part of the analyser to another is based on a mass of evidence. The supposition that inhibition therefore spreads from one area of cerebral cortex to another, or from one depth to another depth, rests on no evidence at all.

To return to our own conception of the generalization of stimuli. When first conditioned a stimulus has excitant properties in virtue of its general character only. It will be seen that the irradiation and concentration of the response can equally well be explained on a basis of varying degrees of correspondence, of stimuli one with another in regard to their general properties.

The specific effect of this or that number of vibrations, or this or that particular area of skin, is acquired only by differentiation, and that in turn only by offering other distinguishable stimuli. Thus 'a tone' is differentiated as a 'high tone' and then a 'very high tone' and then 'a tone of a particular pitch,' so that the possible number of stimuli fulfilling the essential requirement is narrowed by exclusion of others which are being negatively endowed. Any property of a stimulus may be given the significance of a signal, e.g., its duration, its strength, its rate of repetition, its cessation, or its onset. It is therefore possible for a stimulus to function as a signal in virtue of general or of particular properties. Concentration may surely be looked upon as the differentiation of the particular from the general, and irradiation the converse. We may further extend this hypothesis to deduce that the more contrasted two stimuli may be the less their effect upon each other, for the fewer will be their common identifiable signal properties. There is abundant evidence that this is so. In experiments upon tactile sense[13], for instance, the points nearest to an inhibitory point suffered the greatest inhibitory effect, and a progressive lessening of effect was observed the further away the application of test stimulus. To call this waning of effect with distance a spread of inhibition or excitation within the analyser leaves the means of spread open for further interpretation, but as used by Pavlov it also gives a distinct impression of a wave of inhibition spreading through layers of cortical cells, an analogy which Pavlov himself tends to further when discussing his hypothesis of sleep. The evidence does not justify diffusion of any process, still less does it substantiate a hypothetical process spreading beyond the bounds of the part of the cortex concerned with sensory discrimination. It concerns only the development of the capacity to discriminate narrowing or widening contrast, in quantitative terms of conditioned response linkage.

Dissimilarity is a stimulus-property capable of deciding potency in differentiation. The potential value of a stimulus is related to its similarity to already existing stimuli. If it partakes the properties of a similar established signal Pavlov advances the supposition that the established signal has affected the cortex by positive or negative influence. The fundamental deduction should be that the cortex is unable to differentiate between the two owing to lack of dissimilarity *in the stimuli*. Closer differentiation is only made by contrasted conditioning. I would like to distinguish between *spontaneous differentiation* and *conditioned differentiation*, the former being the property of the cortex of estimating dissimilarity spontaneously, the latter the property of the cortex of estimating dissimilarity by conflicting conditioning. Natural differentiation varies inversely with the multiple of properties common to any two stimuli; the degree of generalization of the effect is the

degree of generalization of a common property and not the influence of the cortical mechanism for one on that for the other.

When a differentiation is conditioned each step in the approximation of the differentiation is the establishment of two new reflexes, each to a more specific property than the last. The new signal potentialities become associated with more discriminating parts of the analyser; their interaction is on a higher plane. The ' pattern ' is changed, but is the same ' pattern ' in a fresh place. The plan of potential effect of other related stimuli can still be predicted from their relationship to the established signals and still remains a function of the natural discriminative power of the sensory cortex.

If a stimulus possesses specific properties which it is possible to condition but which the cortex does not differentiate spontaneously these specific properties must always be appreciated by the sensorium. Why are they not differentiated spontaneously if at all? This is the crux of the problem and its solution is the elucidation of the mechanism of the sensory cortex. Pavlov's solution is that such finer discriminations, each reaching a particular point in the analyser, remain impotent until the point is affected by a spread of effective influence from a neighbouring point of established sign. How this spread originates or takes place he does not explain. It has no counterpart in spinal reflexes. Beritoff[14] states that there is ' general increase in excitability of the whole cortex ' during the period of formation of the conditioned response, allowing widespread temporary connexions to be set up between the cutaneous analyser and the motor apparatus. If instead we postulate that the sensory cortex can appreciate finer discriminations by integrative function of sensory correlating neurones, and that this function occurs only in the presence of strong facilitation provided by the attentive process hypothecated earlier above, then a positive solution of sensory discrimination is found. Pressed to activity by a conflicting environmental situation, the process of attention facilitates a higher discrimination of sensory information and the essential conditioned potential linkage is extended to be attached to this higher plane. Distraction lessens the facilitation so that the earlier low grade differentiation may be restored (disinhibition)[15]. Pressure of circumstance leads to increased cortical ' vigilance ' in the sense proposed by Henry Head[16].

Thus a positive effect builds superstructure to existing low-grade differentiation.

Contrast in time produces a waning of effect just as much as contrast in space, and the time relations of ' irradiation of inhibition ' obtained from the experiments of Kogan and Andréev and others[17] are readily explained on a basis of increasing time-contrast interacting with space-contrast to give compound differentiations.

LOCALIZATION OF FUNCTION IN THE CEREBRAL CORTEX.

The cerebral cortex, even in its earliest beginning (the neopallium of the comparative anatomists), is the meeting ground of all sensory pathways. Pavlov finds by ablation experiments that only finer discriminations in any range of sensation require the area of cerebral cortex commonly accepted as the specific area for that sensation. Thus crude visual discriminations are possible in the frontoparietal cortex, crude auditory discriminations in parts other than the temporal cortex. From experiments upon maze habit learning in rats and monkeys Lashley[18] concludes that there is a wide generalization of functional effect in the cerebral cortex. Thus these two routes of approach have reached similar conclusions regarding localization of general effects.

A recent excellent review of the question of localization in the cerebral cortex by Hines[19] summarizes the clinical, anatomical and histological evidence. From the physiological point of view the lack of localization of specific function becomes more and more apparent.

The motor cortex gives a more direct index of its function than any other, but even here fluctuation in function has for a long time been known[20]. More recently Miss Cooper and the author[21] have found that responses from a ' cortical point ' in the motor area show evidence of gross admixture of mutually contradictory functional units. Hence fluctuation in function of the point under electrical stimulation may represent only relative selection of one or other element by the spinal mechanism. Nevertheless, a general pattern of localization can be mapped by electrical stimulation and clinicopathological analysis. The present writer would insist that these functional analyses may be, and almost certainly are, but the reflection of a *relative concentration* of like functional elements. How far scattered the outlying elements may be is a matter for conjecture, for even ' motor ' projection cells may not resemble the largest Betz-cells[22]. The response to electrical stimulation is probably only the expression of algebraical summation in the relatively greatest concentrate of functionally similar elements. The microscopically intermingled mosaic of function prevents the artificial stimulus of the experimenter from selecting in its purity any one of its composite functional patterns. The immense practical clinical use of what is already known of motor localization is because disease often affects the motor cortex just as does the electrical stimulus. Clinical evidence points to greater concentration of motor cortical function in man than in animals, but even so localization is far from being absolute in any sense.

So too the calcarine cortex, though it bears a rough pattern corresponding with retinal segments, and though the knowledge of this pattern can be of the greatest practical value in detecting disease by perimetry, has no

essential attribute of cortical function. As Collier has indicated[23], it is little more than an entry zone to the cerebral cortex. No discriminative function whatever has been delimited within it, while at least some visual discriminations are possible beyond its limits[1, 2].

In such a commingled, heterogeneous organ there must be a discriminative mechanism to which impulses of a primary sensation are relayed on their arrival at cortical levels. This discriminator must be able to extract the utmost significance from any stimulus combination. The site of convergence of one sensation upon another is most simply related to a superposed correlating neurone of the discriminative mechanism. This mechanism may, without anatomical identification, be pictured as a constituent of the whole cerebral cortex wherein, all sensations meeting on equal terms, the ultimate outcome is the result of connexions facilitated by the proprioceptive repercussions which reach the same nexus.

The failure of attempts to localize specific discriminations within this discriminative organ drive one to the provisional conclusion that there is no areal localization within it, and localization in depth gives little satisfaction. The most constant evidence from learning experiments is that quantity of cortical substance determines degree of general efficiency[16]. We have postulated within the organ the effects of a labile facilitating mechanism, attention, against which there is neither functional nor structural evidence. We may presume the discriminative mechanism itself to be a layer of nerve-cells, but there is no conclusive evidence that it is an identifiable layer such as the middle granule layer, or ' receptive layer ' of Bolton[24].

In the discriminative cortex there is widespread functional representation of proprioception although there is a relatively delimited entry zone in the parietal cortex. Proprioceptive sensation, from its very necessity in purely motor acts, is everywhere in close functional relationship with motor integration. Thus may these two essentials of the conditioned response fuse with a functionally if not structurally homogeneous field.

SLEEP.

It was argued earlier that a process of attention could, by subsidizing any particular mechanism of the cortex, heighten the activity of that mechanism as against that of all others. When this ' attentive ' process is depressed by satiety, or disintegrated by distraction, the conditioned response will not manifest itself. This failure may be only relative, in the sense that it lacks merely the facilitating process. In this way sleep can be explained as the complete suppression or disappearance of the process of attention, leaving all cortical processes subliminal. If the ' irradiation ' of inhibition of Pavlov occurs only as a mechanism of stimulus discrimination wholly

dependent upon the contrast property of the stimulus and not as an inhibition of cortical neurones, then the cause of sleep must be looked for in the properties of the very signals initiating the experiments in which it occurs. It is significant that the most potent condition for sleep is that long interval during which in ' trace reflexes ' the cerebral cortex is somehow judging time, which it presumably does by attention fixation on some bodily rhythmic function such as respiration. Monotony is the most potent quality of stimulus in predisposition to sleep. The notion of a subcortical (from clinical and physiological evidence possibly thalamic) primitive sensory mechanism concerned in the appreciation of newness or vividness (primitive contrast) of stimulus, and having the power to facilitate the appropriate field of the cortical discriminating mechanism, provides a working hypothesis which accounts for the process of attention in the alert state. The fatigue, or exhaustion, or simple lack of stimulation of such a mechanism accounts for the phenomenon of sleep without the postulation of any active negative process. The transitional states of hypnosis remain as transitional states both on the above hypothesis or on the hypothesis of irradiation of inhibition.

We have already regarded disinhibition, the revelation of the positive element in negative by external distraction, as evidence of the compound nature of true cortical inhibition. This conception requires that the negative superstructure of a conditioned inhibition needs more facilitation from attention than the original positive response on which it was founded. In this way the hypothesis of functional impairment of a mechanism of attention as an explanation of sleep may be used to explain the excitation immediately preceding sleep[25] when attention is presumably impaired, and the ' ultraparadoxical ' phase succeeding sleep[26] when grading of attention must also occur. The fact that ' inhibitory reflexes ' are at first the only responses to be obtained from an ' analyser ' subjected to surgical damage[27], and the further evidence that any damage to the cortex impairs all inhibitory processes greatly[28], suggest that here there is the result of fixation of attention upon a functionless part of the analyser.

FIXATION OF CORTICAL PATHWAYS.

As to the nature of the mechanism of the formation of the transient sensorimotor associations which constitute conditioned reflexes, and probably learning and mind, there is still no direct evidence. The spinal reflexes have no equivalent permanent or long-delayed effects, and their automatism is presumably the reflection of anatomically predetermined connexion. Between conceptions of physiochemical reactions, flow of neurin, interception of neuroglia, or protrusion of dendrites, there is little to choose. The importance of proprioception is manifest, and it is here suggested that a train of events, associated with a running commentary of proprioceptive information and

finishing with proprioceptive satisfaction of the original cause of attention, in some way lowers the resistance of the whole path. It would seem preferable, by analogy with spinal reflex phenomena and by the speed of performance of cortical reflexes, to suppose that the process is one of lowering of synaptic resistance. The modern conception of reflex mechanisms in the spinal cord[8] suggests that the lowering of path resistance in cortical linkages is not so much by wearing lower the threshold at the synapse as by the mutually facilitating effects of two paths converging on the same neurone link.

The experimenter with conditioned responses is not dealing with a relatively isolated receptive pathway as is the case in experiments upon spinal reflexes. The receptive cerebral cortex is under constant stimulation, for on it afferent channels bear a constant stream of information. Negation may be implied by change in a particular combination, and be potent in effect. Sequence in time lends differing signal values to the same combinations, so that the apparent paradox that absence of stimulus may itself be a stimulus will occur if an expected sequence be disrupted.

Under these circumstances a cortical process cannot be regarded as a chain, for the whole sensory cortex is welded together with a proprioceptive component into each response. A closer analogy may be that of a weave of cloth, where the individual threads are intermeshed to make a whole, and where for a short time after its unravelling each thread bears a trace of its part of the weave. The motor response is in some way included in the ' weave ' although it may not be manifest until late in the process. The experiments of Lashley[16] show that though the general effect resembles the formation of a pattern, the details of the pattern are not essential.

CONCLUSION.

In conclusion it may be emphasized that Pavlov has without question gained recognition of the ' conditioned reflexes ' as a physiological approach to the problems in the function of the cerebral cortex. That being so it is now very necessary to plead the restriction of the use of such terms as ' inhibition ' and ' reflex ' to their narrower definition, and to point out the limitations of the direct application of functional conceptions to anatomical structure. In support of my contention that interpretation is not thereby restricted some alternative views are here proposed which provide a working hypothesis to explain cortical phenomena on a positive basis, and one which conflicts less with present conceptions of spinal reflex phenomena.

In order to estimate the presence and nature of nervous processes within the cerebral cortex the amount of effect obtained simply because the cortex fails to make discrimination must first be assessed and discounted. Assessment of degree of difference between stimuli in its finer shades requires some

subjective reasoning on the part of the assessor; but, for the purpose of analysis of the protocols of most of the conditioning experiments so far published, contrast may be valued *purely objectively* by plotting the greater or less approximation of purely physical properties of the stimulus, e.g., the number of vibrations a second in a tone, or the distance apart of points of stimulation on a skin surface. Reaction to difference reveals the true analytical function of the cortex.

In the application of the results of the study of conditioned responses to the human cortex the most crucial problem appears to be whether a mental satisfaction can be made equivalent to a physical one. If a ' psychological ' satisfaction can stamp in the train of events preceding it then the application of ' conditioning ' to mental habits is clear; but the problem is beyond the scope of experimental physiology. Application of contrast differentiation to problems of mind and behaviour brings all the difficulties of estimating contrast values of abstract stimulus properties objectively. It is precisely at this point that the application of conditioned responses to man meets its greatest difficulty, whatever be the theoretical basis it is attempted to apply.

The establishment and analysis of the conditioned response are by far the most outstanding contribution to the physiology of the cerebral cortex in our time. It is far from the intention of the writer that the criticism and working hypotheses here outlined should in any way, even in appearance, detract from the appreciation of such monumental work. Rather it attempts to give a fuller understanding of Pavlov's work. Between the knowledge of the sensory processes in the cerebral cortex thus gained, and the little definite knowledge that has been gained of the outgoing cortical motor pathway, there remains a complicated nervous mechanism still unexplored.

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Editorial.

SOME PROBLEMS OF GENERAL PARALYSIS.

GENERAL paralysis has always been something of a mystery, and it may therefore be worth while to review some of the more recent attempts which have been made towards solving its problems. In this disease, as always, diagnosis means more than attaching the correct label to a case. An understanding of the pathological processes at work, and of the means whereby they produce physical symptoms, is also needed. Not that the correct label is always attached, since the diagnosis of general paralysis is often made on inadequate grounds. Some are inclined to make this diagnosis in every case of mental deterioration in which it is supported by the examination of the blood and cerebrospinal fluid. But by relying too much on laboratory diagnosis we are apt to label as general paralysis every case with the paretic type of gold-sol reaction, and a positive Wassermann reaction in the cerebrospinal fluid, neglecting the fact that many of the more severe forms of meningeal syphilis give strong reactions of this type in the earlier stages of the disease. Others consider that the physical components of the disease, especially the trombone tremor of the tongue, should be present before a definite diagnosis is made. But this attitude merely delays the institution of appropriate treatment, since there is evidence that the lesions of general paralysis may be present in the patient's cerebral cortex at a time when his symptoms are purely mental.

Another error that is frequently made is to regard as taboparesis every case of tabes in which mental symptoms make their appearance. The pathological examination of the brains of such cases often shows no evidence of syphilitic disease of the cortex, or if this is present, it may not have the characters of general paralysis. Tabetics are at least as liable to mental disease as the rest of the population and their brains may be damaged by such syphilitic processes as chronic hydrocephalus

and cortical vascular disease. But undoubtedly many cases of tabes do develop general paralysis, just as many cases of general paralysis have early tabetic lesions of the spinal cord. There is thus a definite connexion between the two diseases, on the pathological as on the clinical side, although our knowledge of the pathology of the two does not yet furnish us with a reason for this connexion. Whereas in general paralysis the etiological agent can be found in considerable numbers in the cortex in the majority of cases at all stages of the disease, there has been no conclusive evidence of its presence in the spinal cord of tabetics. Nor indeed is the number of cases in which spirochætes have been found in the meninges of tabetics sufficient to prove their constant presence there. Jahnel appears to have found them in the subdural space, and Richter claims to have found them in the meningeal pocket near the dorsal root ganglion; but these were isolated findings among a large number of cases examined. In fact our knowledge of the pathogenesis of tabes has scarcely advanced during the last twenty years.

The pathogenesis of general paralysis is by comparison well understood. The presence of spirochætes in the cortex shows it to be a subacute syphilitic encephalitis, and disposes at once of the older theories that it is a special form of degenerative process. The degeneration of nerve-cells and -fibres seems to be as directly due to the toxins which emanate from the spirochætes as are the perivascular and meningeal infiltrations and the neuroglial overgrowth. The reaction of the microglia, with the formation of rod-cells and the presence of inorganic iron in their processes, is so characteristic of general paralysis as to be pathognomonic; but the origin of the iron is still undecided. Although it might be derived from the nuclei and Nissl granules of the nerve-cells, its absence in other forms of cortical degeneration is against this supposition. Most authors consider that it is derived from the blood, and this theory is supported by the collections of similar iron-containing material in the walls of the cortical vessels. The Prussian blue reaction in the cortex is thus of the greatest importance for diagnosis; and while we are scarcely justified in the present state of our knowledge in refusing to consider as general paralysis a case in which this reaction is negative, its presence is undoubtedly of much greater diagnostic value than such naked-eye changes as the granular ependymitis, meningeal thickening and cortical shrinkage, on which diagnosis was often based in the past. For

granular ependymitis may occur in its most intense form in chronic meningeal syphilis and has no necessary relationship to general paralysis.

The involvement of the basal ganglia in general paralysis is of interest in both its pathological and clinical bearings. It is known that the putamen and caudate nucleus are almost constantly affected by a process which differs little from that in the cortex. Rod-cells and plasma-cells round the vessels are often especially noticeable here. On the other hand the globus pallidus is as constantly spared. The optic thalamus may or may not be affected. This selectivity is difficult to understand, even if we postulate that structures of similar developmental age, such as the neostriatum and neopallium, are especially liable to be attached by the spirochæte pallida. For although the lesions in the basal ganglia are similar to those in the cortex, spirochætes have very rarely been found in this situation.

Another problem to which a considerable amount of attention has been devoted of late years is the method of action of malarial therapy. The earlier workers on this subject found evidence of a transition of the morbid process from the diffuse inflammatory type of general paralysis to the focal gummatous lesions of tertiary syphilis. Later work, however, has not altogether confirmed this. Although gummata and local ulcerations may occur after malarial treatment, the relapse which follows in many cases is found to be associated with the usual pathological picture of general paralysis. At the same time all are agreed that spirochætes disappear from the cortex very rapidly after the onset of malaria, and it is therefore natural to attribute the clinical improvement to destruction of the etiological agent.

What determines this destruction of spirochætes is still uncertain. It has been attributed by some to antibodies to the malarial plasmodium which have been supposed to have an affinity for the spirochæte; by others to the increased permeability of the vessels which it is known to cause; and by still others to the pyrexia which is supposed to be directly harmful to the spirochætes. To each of these theories objections have been raised, and none is completely satisfactory; but the fact that other pyrexial agents are often equally effective militates against the first hypothesis. It has been held that malarial treatment increases the amount of cellular exudate in the cortex; but this must be largely a matter of speculation, for it is

impossible to tell, in any case of the disease, what degree of cellular exudate was present before malarial therapy was instituted.

To regard general paralysis as an inflammatory disease of the cortex does not therefore altogether explain its peculiar characters, and our treatment is still hampered by our imperfect comprehension of its pathogenesis. For example, if the disease in the basal ganglia is of the same nature as that in the cortex we should expect it to be equally influenced by malarial therapy, whereas several workers have found that cases in which death occurs during a clinical remission may still show abundant inflammatory changes in the basal ganglia, although the cortex presents an almost normal appearance. Some indeed have gone so far as to suggest that relapses are due to the persistence of the disease in the basal ganglia with eventual spread thence to the cortex.

Perhaps the investigation of these problems has been attempted too much by histological methods, which are always more apt to raise questions than to answer them, and it may be that a different line of research is needed. Meanwhile the malarial treatment of the disease, like so many other forms of therapy, remains empirical.

Abstracts.

Neurology.

NEURO-ANATOMY AND NEUROPHYSIOLOGY.

[1] **On the presence of branching cells, similar to microglia, in the heart, the voluntary muscles, and the urinary bladder** (Sulla presenza di cellule ramificate simili alla microglia, nel cuore, nei muscoli volontari e nella vescica urinaria).—F. Visintini. *Riv. di pat. nerv. e ment.*, 1931, xxxvii, 36.

The author has applied Bolsi's methods in investigating the question of identification of the microglia with the reticulo-endothelial system, and has had positive results in regard to heart, voluntary muscles and urinary bladder. The cells found in the bladder recall the interstitial cells of Cajal in the pancreas and intestine.

R. G. G.

[2] **Observations on the method of staining the microglia** (Osservazioni sui metodi ad impregnazione della microglia).—F. Cardona. *Riv. di pat. nerv. e ment.*, 1930, xxxvi, 603.

The author describes the various methods of staining the microglia. He experimented with those which start from the fixation of human material in formalin and believes that the most successful is the second variety of Penfield for oligodendroglia and microglia. He explains a new method of silver-staining the microglia in human material fixed in formalin; it consists in first washing in a bath of pyridine and water and then staining by the second method of Achucarro-Rio Hortega for the connective-tissue network.

R. G. G.

NEUROPATHOLOGY.

[3] **Head injuries: effects and their appraisal. I. Experimental studies of induced convulsions and ventricular distortion in the cat.**—S. Bernard Wortis. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 783.

The reactions of animals with fractured skulls and post-operative cerebral scars were studied as regards both their behaviour to a standardized

convulsant (camphor monobromide) and the effects produced on the ventricular system of the brain following such procedures.

It was found that aseptic laceration of the brain without removal of the products of trauma in the cat results in ventricular distortion due to (a) meningocerebral adhesions, and (b) contracting cerebral cicatrix.

Head trauma resulting in the escape of blood into the cerebrospinal fluid often gives rise to mild bilateral ventricular dilatation in the absence of grossly demonstrable meningocerebral adhesions or a cerebral scar.

Aseptic laceration of the brain and head trauma resulting in fracture of the skull increase the animal's sensitiveness to a standard convulsant over the period of observation.

R. M. S.

[4] **Head injuries: effects and their appraisal. II. The rôle of the microglia.**—Lewis D. Stevenson. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 787.

A study of the neuroglial changes after aseptic puncture of the cortex of the cat's brain permits the conclusion that injury to the brain is not always as harmless as one is sometimes apt to think. For example, after a needle puncture of the brain during an operation, one may be sure that the microglia reacts in this way, and it is hard to tell just where their activity will end and with how much loss of brain tissue. From this point of view the matter has a medicolegal aspect of some importance. Undoubtedly, some of the cases following brain trauma that have been classified as instances of neuroses show a train of symptoms that is not dependent on a desire for compensation, but is due to the phagocytic action of the microglia with its attendant phenomena. At least, in such a case of suspected neurosis, the patient is entitled not only to an X-ray examination of the skull, but also to an encephalogram.

Another important question, which cannot be fully answered by the present incomplete studies, is whether, in view of these facts, it would not be better to operate in more cases of skull fracture in which brain injury has taken place in order to remove any damaged areas of the brain, thus diminishing, if possible, the phagocytic inroads of the microglia and the subsequent scars formed by the astrocytes.

After the microglia has devoured the tissue debris, indeed, while this is still in progress, the astrocytes begin to change in the contiguous areas; they multiply amitotically and form at last a dense scar composed of neuroglia cells with strongly developed fibres. Each astrocyte sends out one or more of these fibres, each with a sucker foot at its extremity by which it attaches itself to a blood vessel or to the under surface of the pia near the injury.

R. M. S.

[5] **Alterations in the structure of the sella turcica.**—K. KORNBLUM. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 305.

ANATOMICAL studies of the sella turcica have shown innumerable variations from the normal. Oval, circular, flat, pneumatic, thick heavy dorsum, small thin dorsum, faint indistinct dorsum and the bridged sella types are recognized.

Alterations in the structure of the sella turcica, as revealed by X-ray, are, in a high percentage of cases, indicative of intracranial disease.

Lesions capable of producing changes in the sella turcica may be classified according to the characteristics of the changes produced, these changes being dependent on the location of the lesion.

Deformations of the sella are, in themselves, rarely diagnostic, but when correlated with other X-ray observations in the skull, as well as with the clinical manifestations, they offer valuable aid in the localization of suspected intracranial lesions.

R. M. S.

[6] **Blood lipase, diastase and esterase in multiple sclerosis.**—L. A. CRANDALL and I. S. CHERRY. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 367.

A LIPASE capable of splitting olive oil appeared in 78 per cent. of the cases of multiple sclerosis, in 80 per cent. of the cases of liver diseases and in 7·6 per cent. of cases of other diseases.

Diastase values above what may be considered normal were found in 47·6 per cent. of the cases of multiple sclerosis, in 75 per cent. of the cases of liver disease and in 8·3 per cent. of the controls.

Blood esterase (active on ethyl butyrate) showed no significant changes.

Animal experimentation bearing on the significance of these observations is discussed.

It is suggested that the best interpretation of the facts that can be made at the present is that they signify a functional disturbance of the liver in multiple sclerosis.

R. M. S.

[7] **A serological study of multiple sclerosis.**—A. WEIL and D. A. CLEVELAND. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 375.

IN 26 cases of multiple sclerosis the influence of the patient's serum on the spinal cord of the rat was studied. In agreement with Brickner's experiments with plasma of patients with multiple sclerosis it was found that a larger

number of sera from cases of multiple sclerosis than of normal sera acted destructively on the spinal cords of rats. Such action, however, could also be demonstrated in sera from other diseases, and the difference did not seem to be large enough to warrant the drawing of conclusions as to the importance of increase in lipase in the etiology of multiple sclerosis. Furthermore, experiments with active pancreas lipase on the spinal cords of rats gave a negative result.

The amount of inorganic phosphorus in the serum of patients with multiple sclerosis was 3·4 mg. per 100 c.c. on the average as compared with 4 mg. in normal cases, 4·2 mg. in 21 cases of eight different diseases and 4·4 mg. in cases of syphilis of the central nervous system. In 40 per cent. of the cases of multiple sclerosis the inorganic phosphorus of the serum was below 3·3 mg., and in 65 per cent. it was 3·5 mg. or less.

R. M. S.

[8] **Studies in the blood volume of epileptics.**—Morgan B. Hodskins, Riley H. Guthrie, and James Z. Naurison. *Amer. Jour. Psychiat.*, 1932, xi, 623.

An attempt is here made to show that cerebrospinal pathology in epilepsy is variable. Dehydration is a factor in common among methods of treatment which modify the seizures. The incidence of epilepsy is low in diseases in which there is present a low blood volume or a tendency to dehydration. Alkalosis, œdema, and decreased oxygen tension, conditions favouring convulsions, are closely interrelated, as are acidosis, tissue dehydration and increased oxygen tension, conditions which decrease seizures. A disturbance in the vasomotor control of the cerebral vessels is suggested as the precipitating factor of the epileptic convulsion. A trend towards higher blood volume values was found in 78 epileptics as compared with 42 controls. A low blood volume was found during convulsive seizures and during fainting attacks. Acidosis, as produced by ammonium nitrate therapy, is not sufficient to control seizures.

C. S. R.

[9] **The histopathology of triorthocresyl phosphate poisoning: the etiology of so-called ginger paralysis.**—M. I. Smith and R. D. Lillie. *Arch. of Neurol. and Psychiat.*, 1931, xxvi, 976.

During the winter and early spring months a peculiar and new type of multiple neuritis afflicted thousands of victims in the United States. It was shown that the disease had resulted from the consumption of an adulterated fluid extract of ginger used for beverages or other purposes. The

adulterant responsible appeared to be the phosphate of orthocresol and the authors used this experimentally to ascertain clinically the exact anatomical seat of the lesion of the neuromuscular apparatus.

The results indicate that the multiple neuritis of this condition is essentially a degeneration of the myelin sheaths of the peripheral nerves, with a variable amount of relatively moderate central degenerative changes affecting the anterior horn cells throughout the spinal cord, but more often in the lumbar and cervical regions.

Essentially similar lesions were observed in experimental animals in which partial paralysis was produced by means of triorthocresyl phosphate.

R. M. S.

[10] **On the variations in the histopathological picture of general paralysis after malarial inoculation** (Sulle variazioni del quadro istopatologico della paralisi progressiva in seguito alla inoculazione della malaria). —A. Mari. *Riv. di pat. nerv. e ment.*, 1931, xxxvii, 740.

The histological study of seven paretic brains treated with malaria, from patients who died at various intervals after the treatment, has only allowed the author to show a diminution of the inflammatory components in two cases. In all a parenchymatous change was apparent and none showed a tendency for the paretic process to be transformed into a luetic one. The search for spirochætes repeated several times was always negative.

R. G. G.

[11] **A new contribution to the recognition of anomalies of the skeleton in hereditary ataxia** (Nuovo contributo alla conoscenza delle anomalie scheletriche negli eredo-atassici).—U. de Giacomo. *Riv. di pat. nerv. e ment.*, 1931, xxxvii, 498.

The author describes three typical examples of Friedreich's disease, in which he has examined the cranium and the vertebral column radiologically. He comes to the conclusion that the spinal malformation in the lumbosacral region which was first described by him in this disease is in reality a constant feature of the complex symptomatological picture of the affection. The greater or less maldevelopment of the posterior cranial fossa described by Bartolotti and Mattirolo, though less constant, is another example of a fundamental morbid process in a generalized familiar dystrophy of the osseous and nervous system, resulting in a pathological brachycephaly.

R. G. G.

SENSORIMOTOR NEUROLOGY.

[12] **Lead poisoning in children: the cerebral manifestations.**—C. F. McKhann. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 294.

Lead poisoning is seen occasionally in infants and children from the prolonged use of lead nipple shields or from the ingestion of water containing lead; also lead is reported to have been obtained from face powder containing lead used by the child's mother; however, the most common cause of the ingestion of lead appears to be the habit of small children of chewing paint from toys, cribs or woodwork of the house. If the ingestion of lead paint continues for any considerable time, symptoms of intoxication result. True perversion of the appetite, so-called pica, appears to develop in some children; in addition to paint, sand, coal, cloth or hair may be ingested. Mentally defective and highly neurotic children are prone to show evidences of pica; bizarre appetites may develop in anæmic children, and children harbouring certain intestinal parasites are notorious in this respect.

The early manifestations of lead poisoning are those referable to the gastro-intestinal tract—anorexia, constipation, and colic—associated in most cases with a variable degree of anæmia. More serious symptoms are those referable to the central nervous system—vomiting, frequently of a projectile character, visual disturbances, delirium, stupor, coma or convulsions. These neurological evidences of lead poisoning often are associated with an elevation of the arterial blood pressure, choking of the optic discs or even separation of the cranial sutures. If death occurs, it usually follows a period of coma or severe convulsions. While the heart continues to beat for some minutes, the respirations cease, apparently because of central respiratory involvement.

The cerebral manifestations of lead poisoning appear to be due to extreme cerebral œdema resulting from the deposition of lead in the brain. This marked cerebral œdema was observed by Chvostek in 1897, and has been produced experimentally in laboratory animals by Weller.

If the patient survives a severe encephalitic stage, permanent cerebral sequelæ may remain, among them blindness, cerebral palsy, cerebral atrophy and degeneration, internal hydrocephalus, epileptiform seizures and mental deficiency, all presumably the result of impaired circulation in the brain during the prolonged state of increased intracranial tension.

The development of encephalitic manifestations is more frequent in children than in adults, whereas the type of neurological involvement commonly seen in adults, peripheral neuritis, has been encountered relatively seldom in children.

The early diagnosis of lead poisoning based on a carefully taken history and physical examination, confirmed by rœntgenological laboratory data, should lead to the institution of active therapy, which may result in the

prevention of the development of serious neurological manifestations. In the presence of the acute, severe cerebral manifestations, attention must be directed toward the control of greatly increased intracranial tension.

R. M. S.

[13] **A productive-degenerative form of endarteritis of the small pial vessels : report of a case showing unusual clinical and histologic features.**— D. ROTHSCHILD and K. LOWENBERG. *Arch. of Neurol. and Psychiat.*, 1932, xxvi, 993.

THE authors report a case showing certain arterial lesions in the central nervous system of an unusual type.

Clinically, there was a combination of pyramidal, extrapyramidal, and pseudobulbar signs, with an unusual manifestation of tonic innervation in the left hand. The course of the illness was more continuous and the dementia was deeper than that ordinarily observed in cerebral arteriosclerosis. The results of the serological tests were negative. The clinical picture was complicated by the presence of a paraplegia in flexion. This was found to be due to an encapsulated tumour of the cauda equina. The tumour was evidently an independent process, for it bore no apparent relation to the vascular changes.

The vascular changes were limited to the smaller arteries and arterioles of the central nervous system. The first alterations consisted in swelling and proliferation of the endothelial cells, whereby masses of large, rounded elements with translucent but slightly granular cytoplasm were formed. This resulted in complete or partial blocking of the lumina of the affected vessels. Following this, the newly formed cells underwent severe fatty degenerative changes, which often spread to the media. Complete disintegration of the walls of the vessels frequently ensued, with the occurrence of thrombosis and hæmorrhages. The end stage of the process consisted in connective tissue organization of the involved vessels. There was no tendency to recanalization, and splitting of the elastica interna was not observed. Calcification did not take place.

The nature of the vascular disease would seem to be almost as obscure as its etiology. Histologically, there was a combination of productive and degenerative changes which, theoretically, might result from the association of arteriosclerosis and endarteritis syphilitica attacking the smaller cortical vessels. It is, however, very improbable that two independent disorders would merge with each other completely enough to produce alterations of a uniform character in practically all parts of the central nervous system.

The possibility of a hitherto undescribed type of disorder must be entertained.

R. M. S.

[14] **Head injuries: effects and their appraisal. III. Encephalographic observations.**—E. D. Friedman. *Arch. of Neurol. and Psychiat.*, 1932, xxvii, 791.

In the group of cases reported, eight presented definite evidence of fracture of the skull; in two it was suggestive; two of the cases exhibited subarachnoid bleeding following the initial trauma, but in the majority there was no evidence of either fracture of the skull or subarachnoid bleeding. There were nine cases of posttraumatic epilepsy; six showed objective signs of a residual focal lesion in the brain. In one case there was evidence of a gross lesion in the substance of the brain without subarachnoid bleeding or fracture of the skull. In a similar instance studied more recently at autopsy, a large intracerebral hæmorrhage was found without signs of disease of the cerebral vessels. There was also no evidence of fracture or subarachnoid hæmorrhage.

In all but one of the cases studied, definite changes in the encephalogram were demonstrable. These consisted of dilatation of the ventricles, considerable accumulations of air on the convexity of the brain and migration of the ventricular system toward the site of the lesion. These deviations from the normal were found either separately or in combination.

It is, of course, understood that no sweeping conclusions can be drawn from this relatively small group of cases. Yet the encephalographic observations were so uniformly abnormal that they are suggestive of an organic basis for some of the symptoms in the posttraumatic. In a number of the cases signs of focal disease were demonstrated, but even in those with only general symptoms a similar process probably forms the basis of the complaints.

The author concludes that encephalography offers a valuable means of differentiating between organic and functional syndromes.

R. M. S.

[15] **Observations upon abnormalities of the pupils and iris in tabes dorsalis, general paralysis and taboparesis: with a consideration of their bearing upon the pathogenesis of the Argyll Robertson pupil.**—W. M. McGrath. *Jour. of Ment. Sci.*, 1932, lxxviii, 362.

The pupillary phenomenon of Argyll Robertson is a complex one and no one of its components is more constant than another. The author asserts that the 'true' Argyll Robertson pupil is invariably associated with neurosyphilis and is never found apart from that condition. It commonly develops segmentally, becoming uniform only when fully developed. It is to this segmental development of iris changes that segmental loss of light reaction and pupil irregularity are due. This mode of development indicates that the underlying nervous lesion must be in the peripheral neurone. The observations made by the author are not compatible with a central lesion in

the midbrain. The Argyll Robertson pupil of non-syphilitic lesions of the nervous system is clinically distinguishable from the 'true' Argyll Robertson pupil. It is accompanied by pupil dilatation, and characterized by an absence of miosis, pupil irregularity or trophic changes in the iris. Theories as to its pathogenesis have no bearing upon the problems presented by the 'true' Argyll Robertson pupil.

C. S. R.

[16] **Researches on the genesis of early hypertonia and the Magnus-de-Kleyn reflexes in man** (Ricerche sulla genesi delle ipertonie precoci e dei reflessi di Magnus-de-Kleyn, dal collo sugli arti, nell'uomo). —V. M. Buscaino. *Riv. di pat. nerv. e ment.*, 1930, xxxvi, 335.

Five personal cases were studied post-mortem and several in the literature are discussed. The author concludes that early hypertonus manifested in man coincidently with the onset of cerebral hæmorrhage, softening, etc., is an expression of lesions not in the pyramidal tracts or in fronto-pontine o temporo-pontine tracts, or in thalamus, but in the corpus striatum of th same side (neo- and palæostriatum) in the mesencephalon (substantia nigra, probably also in the substantia reticulata) and in the pons. If the corpus striatum is spared, hemiplegia from interruption of the pyramidal tract in one hemisphere is found without hypertonia; however in spite of the alteration in the striatum it is sometimes possible to find hypotonia, when the nervous system on the side of the lesion is transformed into a mesencephalic organism.

The Magnus-de-Kleyn reflexes in man result from lesions of lenticular paths in the peduncles of the pons, also perhaps from the descending tracts from this last area. Lesions of the pyramidal and other tracts are not necessarily found. Sometimes these lesions are absent in cases of complete 'mesencephalisation' or because the muscular rigidity is of another origin. The centre for the reflexes in man is situated in the fifth cervical segment.

R. G. G.

[17] **Symptomatology of arsenical polyneuritis.**—G. B. Hassin. *Jour. Nerv. Ment. Dis.*, 1930, lxxii, 628.

The author describes six cases illustrative of the difficulty of diagnosis of this form of neuritis. He remarks that had not chemical examination revealed the presence of large amounts of arsenic in the hair, the etiology and even the nature of the lesions in some of the cases here recorded would have been in doubt. Of equally great important was, in his opinion, the presence of transverse bands on the nails of the fingers and toes. According to Mees such bands are actual deposits of arsenic in the nails and their presence

alone, that is, without a chemical examination of the hair, should, in the writer's opinion, suffice for a diagnosis of arsenical poisoning. They should always be looked for, and their presence would indicate the advisability of chemical examination of the hair. As the number of contributions on the object is so far rather few, it is not possible to estimate the relative value of white bands in the nails and the presence or absence of arsenic in the hair. Some of the cases which have been and still are under his observation showed distinct bands in the absence of appreciable quantities of arsenic in the hair. In one case no arsenic was found in the hair at all though the nail bands were distinct, while the clinical picture of arsenical polyneuritis was quite clear.

It is evident that further observations of cases as outlined in this article should be recorded. It is noteworthy that in none of the author's cases was it possible to determine the source of the arsenic and that the clinical picture was mostly atypical, with prevalence of motor disturbances. R. G. G.

[18] **The syndrome of amyotrophic lateral sclerosis in epidemic encephalitis.** —A. M. Ornsteen. *Jour. Nerv. Ment. Dis.*, 1930, lxxii, 369.

A case of acute epidemic encephalitis followed by bulbar palsy and later a syndrome of amyotrophic lateral sclerosis is reported. A prominent feature of the case is universal myoclonia affecting all the muscles of the body. Lesions of the anterior horns and pyramidal tracts are inferred to explain the amyotrophic lateral sclerosis picture; lesions of the mesencephalon are thought to be the cause of the universal myoclonia rather than ganglion-cell irritation in the motor nuclei of cranial nerves and anterior spinal horns.

R. G. G.

[19] **Syringomyelia with choked disc.**—B. J. Alpers and B. I. Comroe. *Jour. Nerv. Ment. Dis.*, 1931, lxxiii, 577.

A case is described in which as is usual in cases of syringomyelia complicated by choked disc the symptoms of intracranial pressure are so pronounced as to overshadow those of syringomyelia. The question of tumour always arises but in this case as in others the condition is due to hydrocephalus connected with closure of the foramina in the roof of the fourth ventricle.

R. G. G.

[20] **A new familial disease characterised by congenital cataract, and an arrest of bodily, nervous and mental growth** (Nouvelle maladie familiale characterisée par une cataracte congénitale et un arrêt du developpement somato-neuro-psychique).—G. Marinesco, St. Draganesco and D. Vasiliu. *L'Encéphale*, 1931, xxvi, 97.

THIS family consisted of six living children, two of whom were normal, while four presented the combination of cataract, rickets, imbecility and infantilism which forms the title of the paper. No etiological factor could be discovered, and in particular both congenital syphilis and pellagra were definitely excluded. But the blood calcium was found to be well below normal not only in the affected children but also in the healthy children and the father. The authors consider that the cause of the disease was a disturbance of the endocrine balance with special default in the parathyroids. The cataract also seemed to be dependent on diminished parathyroid secretion, seeing that the combination of rickets with cataract is usually associated with tetany. Seeing that good results had occasionally been claimed for the treatment of imbecility with parathyroid extract, the authors subjected their patients to this as well as ultra-violet rays, but without obvious good effect. Injection treatment with parathyroid extract does not seem to have been tried.

J. G. G.

PROGNOSIS AND TREATMENT.

[21] **The dehydration method in epilepsy.**—D. EWEN CAMERON. *Amer. Jour. Psychiat.*, 1931, xi, 123.

DEHYDRATION was carried out on a series of typical institutional epileptics but had no definite effect on the occurrence of fits or on the patient's disposition. The giving of unlimited fluids after a period of dehydration and the forcing of fluids without previous dehydration had no definite effect on the number of fits. The patients were adversely affected by the diet, and preliminary loss of weight was severe. Resistance, too, was lowered. Nitrogen retention either precipitated or complicated stages of excitement and stupor, and acidosis occurred during the excitements. The results obtained in 12 cases were such that this method would appear to be of little value. This conclusion is reinforced by the injurious effects noted.

C. S. R.

Endocrinology.

[22] **Lipoidal substances in the hypophysis of normal and decerebrate mammals** (Le sostanze lipoidi nell'ipofisi di mammiferi normali e cerebrolesi).—V. DESOGUS. *Riv. di pat. nerv. e ment.*, 1930, xxxvi, 31.

THE author conducted previous experiments on birds and now repeats them in dogs. As a result of these experiments he finds corroboration of his previous work, that pituitary lipoidal substance—the indication of activity of the gland—is in excess when sexual activity is in abeyance, and undergoes diminution during periods of sexual activity. This applies both

to normal dogs, and to dogs with cerebral lesions; where sexual activity is lessened, the hypophysis is rich in secretion. From this he infers that the action of the pituitary is in direct opposition to that of the sexual glands.

R. G. G.

[23] **The influence of the intake of certain waters on bodily growth and on the genesis of goitres and thyroid dysfunction** (Influenza dell'alimentazione idrica sull'accrescimento corporeo e sulla genesi del gozzo e delle disfunzioni tiroidee).—R. Corella. *Riv. di pat. nerv. e ment.*, 1931, xxxvii, 355.

As a result of numerous experimental researches conducted for several years on different kinds of animals with regard to the intake of chemically imperfect waters, and from the result of clinical studies on 512 cases of typical and non-typical forms of exophthalmic goitre during more than 25 years, the author has reached the following main conclusions:—

(1) Goitres, increase of weight, and imperfect thyroid function are directly connected with the use of certain goitre-producing waters.

(2) If certain mammals, cats, dogs, etc., drink such waters from birth for a long period goitres are produced.

(3) At the same time the whole organism is injured especially during the growth period.

(4) If human beings, especially women, drink these waters habitually, a goitre is almost certainly produced.

(5) Such persons may show any degree of thyroid dysfunction up to typical forms of exophthalmic goitre, the latter being simply the last link in a chain of thyroid affections.

(6) The author thinks that this water contains specific germs or toxins which have a special affinity for the thyroid gland.

R. G. G.

Psychopathology.

PSYCHOLOGY.

[24] **Sentiment and social organization.**—H. Banister. *Brit. Jour. Psychol.*, 1932, xxii, 242.

It appears that the attempt to find the foundation of group behaviour in instinctive tendencies fails, as does the psychoanalytic 'libido' theory. The reason is that the group arises on account of the organizing tendency there is in the mind, and analysis, while finding the mental elements, breaks down, in the process, that for which it is seeking. Animals which have the capacity for organization—the sentiment-formation tendency—form more or less

permanent sentiments round suitable objects. These have a determining influence on their behaviour. If such animals come together, either fortuitously or through some common interest, they are liable to form sentiments round each other, and a ' herd ' or group will be the outcome. The ' herd ' may just as well consist of a boy, a dog, and a lamb as of animals of the same species. When sentiments are formed round ideals altruistic behaviour is possible and probable.

One of the most pressing of psychological problems is the study of the conditions which are most conducive to the formation of sentiments and the application of such knowledge to the world problems of to-day. For these problems are largely due to the existence of sentiments which have in their progress lagged behind the progress in other fields. Such lack of balance is fraught with grave dangers.

C. S. R.

[25] **The incest barrier: its rôle in social organization.**—Brenda Z. Seligman. *Brit. Jour. Psychol.*, 1932, xxii, 250.

Civilization is seen in the capacity of man to live in organized groups. To this end natural impulses become modified for social gains. The family, the first human group, became consolidated by the acceptance of incest barriers. These barriers were not consciously formulated, but arose, not specifically to check the lust of the paterfamilias, but in the production of a harmonious family group, and actually changed it from a natural to a social group. The sanction for the incest barrier is primarily the persistence through childhood of the infant's belief in the omnipotence of the parents, later developed into a religious attitude and consolidated by rites expressive of ancestor worship. The persisting family is a social group with such survival value that other societies which may have ignored the incest barrier have died out. The family group is the pattern on which all other groups are formed. With the formation of the clan and the classificatory system of relationship the rules of incest became extended. Descent is reckoned not on two conventional principles, but by seven methods; when these are recognized all marriage prohibitions can be seen as extensions of the two primary incest prohibitions, that between parent and child and that between brother and sister, and investigation shows that the latter is the more important in savage society. The restrictions on marriage can thus be looked upon in each society as a reflection of its people's fear of incest. The solution of the familial conflict is influenced by social conditions, and savage life leaves the brother-sister relationship so unsolved that it is a matter of conscious concern, while the parent-child type, especially that between mother and son, usually presents no social problem.

C. S. R.

[26] **Emotional effects produced by the injection of adrenalin.**—HADLEY CANTRIL and WILLIAM A. HUNT. *Amer. Jour. Psychol.*, 1932, xliv, 300.

FROM the authors' experiments, they conclude that in general the injection of adrenalin is not sufficient to produce an emotion. A 'cold' emotion may be aroused, but the lack of any object or reason for the emotion usually deprives it of its genuineness. In a few cases, however, the injection with its subsequent bodily symptoms is adequate to produce a genuine emotion; the mere bodily concomitants are sufficient for an emotional state without the presence of any object or reason.

A few theoretical implications are ventured upon. An analysis of the conscious emotional state reveals its dependence upon the following possible factors: (1) A primary autonomic reaction centred in the autonomic nervous system and involving changes in the vasomotor system, the respiratory system, the viscera, and certain peripheral changes such as sweating and muscular tremor. (2) Secondary behavioural reaction patterns, both instinctive and acquired, dependent upon the cerebrospinal nervous system. This includes such reactions such as flight, attack, facial expression, and vocalization. (3) An intellectual content. By this is meant the presence in consciousness of some object or situation to which the emotion is directed and round which the emotion is intellectually organized. This involves the active participation of the higher logical processes, probably centred in the cerebral cortex. The *usual* emotional state seems to involve a combination of the first and third of these. However, as the only criterion we have of a conscious emotional state is the subject's acceptance of it as such, the writers believe, on the basis of their results, that the first is the only sine qua non for an emotion, for it may in some cases suffice to produce the emotional state. Such cases, nevertheless, are rare.

C. S. R.

PSYCHOSES.

[27] **A statistical study of delusions in the manic-depressive psychoses**—KARL M. BOWMAN and ALICE F. RAYMOND. *Amer. Jour. Psychiat.*, 1931, xi, 111.

A STATISTICAL study in 1,009 cases of manic-depressive psychoses, with 1,408 cases of schizophrenia and 496 cases of general paresis as controls leads to the following conclusions.

Delusions are absent in 43 per cent. of the males and 41 per cent. of the females in the manic-depressive group as compared with 10 per cent. of the males and 7 per cent. of the females in schizophrenia, and 39 per cent. of the males and 42 per cent. of the females in general paresis. The most common type of delusion in the manic-depressive is the persecutory type,

which was present in 20 per cent. This was likewise the commonest in schizophrenia, there being 54 per cent. of the males and 58 per cent. of the females with them. Persecutory delusions in general paralysis were of much the same ratio as in the manic-depressives, but males showed 27 per cent. and females 12 per cent. of grandiose delusions indicating that these are the most common type in this psychosis. The schizophrenic group showed a consistently higher percentage of religious and erotic delusions than did the manic-depressives, whereas the grandiose and hypochondriacal showed no such significant differences. Marital condition apparently had little to do with the type of delusion; and as to age, schizophrenic delusions were less frequent in the younger cases. In the manic-depressives there were more cases of superior intelligence with no delusions than would be expected. There was little correlation between delusions and somatic data but much between delusions and hallucinations.

C. S. R.

[28] **Gastrointestinal motor functions in manic-depressive psychoses**—GEORGE W. HENRY. *Amer. Jour. Psychiat.*, 1931, xi, 19.

FROM rœntgenological observations in 96 cases the following conclusions were reached.

Definite changes in visceral function occur in manic-depressive psychoses. In the manic phase the position of the viscera is from one to two inches higher than in the depressive phases. Hypomanic patients present a marked increase in visceral tension and motility. In manics visceral function has already passed the limit of acceleration and begins to be retarded. Depressed patients present a marked decrease in visceral tension and motility. Gastrointestinal hypotonicity and hypomotility are most exaggerated in those depressed patients who are described as being retarded, hypochondriacal, confused or perplexed. The average time for a hypomanic to evacuate a bariumized meal is 47 hours. The average time required for a depressed case to do so cannot be determined, since 68 per cent. of these retain barium or food residue over a longer period than five days. Without medical aid some depressed patients retain food residue for a period longer than two weeks.

C. S. R.

[29] **The learning ability of schizophrenics.**—GEORGE E. GARDNER. *Amer. Jour. Psychiat.*, 1931, xi, 247.

FROM his study the author concludes that schizophrenics exhibit prepsychotically an inferior learning when compared with a like number of manic-depressive patients. Before the onset of the psychosis they do not go as high in grade status in school as the manic-depressives. Special

abilities in art and music are more in evidence among latent schizophrenics than among those students who later become manic-depressives.

C. S. R.

[30] **A histological study of a series of cases of acute dementia præcox.**—C. B. Bamford and H. Bean. *Jour. of Ment. Sci.*, 1932, lxxviii, 353.

The conclusion of the authors is that there is no characteristic histopathology of the brain in dementia præcox. The most constant feature was a condition of fibrosis affecting the solid viscera, demonstrable both macroscopically and microscopically. The kidney first and the spleen second bore the brunt of this fibrosis and these two organs invariably showed the effects of this process microscopically. The other organs were affected to a lesser extent and tended to exhibit individual variation. In the experience of the writers the usual order of involvement is: liver, adrenal, testis or ovary, thyroid, pancreas, pituitary, pineal gland.

C. S. R.

[31] **Somatic changes in the psychoses. A comprehensive investigation of the bodily functions of thirty psychotic patients by means of clinical, pathological, biochemical, pharmacological and radiological methods.**—Muriel L. M. Northcote. *Jour. of Ment. Sci.*, 1932, lxxviii, 263.

A study of these results show that, although there are in general a number of small deviations from the normal, it is impossible to formulate a definite picture of the somatic changes in any one type of psychosis as opposed to another. Very little parallelism was found between mental and bodily changes and the slight abnormalities found were probably to some extent to be correlated with the ill-health due to neglect of the bodily functions associated with the mental state of the patient.

No gross renal abnormality was present but cases showing slight abnormalities were somewhat high. The determination of the basal metabolic rate gave results which were not satisfactory on account of the fallacies due to difficulties with the patient. The blood-sugar and sugar tolerance tests agreed in their results with the findings of other workers in showing a tendency to hyperglycæmia. The acid-base equilibrium was tested by means of the estimation of the hydrogen-ion concentration of the blood and urine, the carbon dioxide combining power of blood and the carbon dioxide tension of alveolar air. As regards the pH of the urine, no urinary acidity was noted except in two cases associated with acetonuria and glycosuria. This fact is of interest from the point of view of the acidosis

considered by some people to be common in psychotic patients. Mild ketonuria was present in 20 per cent. The hydrogen-ion concentration of the blood gave similar results to that of the urine. The investigations into the carbon dioxide tension of the blood and in alveolar air yielded negative results. Examination of the digestive functions gave many interesting findings. The barium meal showed a preponderance of mild stasis but no evidence of any need for surgical interference. The results of the fractional test-meal could not be correlated with any particular type of psychosis. A striking feature was the absence of any gross abnormality when compared with the prevalence of complaints referred to the digestive functions. It was evident that a study of these necessitates the combination of clinical with physical and chemical methods. The blood showed various abnormalities which singly were trivial but significant when regarded as a whole; 53 per cent. showed secondary anæmia and absolute leucocytosis was low. The examination of the Schilling index proved disappointing in its results, as was perhaps to be expected in the absence of any gross sign of infection. The investigation of the autonomic nervous system gave anomalous results and no definite grouping could be made in this direction. The pharmacological tests showed that the depressed cases tended to show a vagotonic reaction and the manic group a sympatheticotonic one.

It is relatively futile in the present state of our knowledge to add to the already too abundant hypotheses explanatory of mental disorders. It may be suggested that the obvious deviations from the normal found in this study may have as their basis some changes in one or more of the fundamental biochemical reactions of the body, and especially of the central nervous system itself, changes, for example, in tissue respiration and metabolism.

C. S. R.

[32] **A parallel study of the psychogalvanic reflex and the hyperglycæmic index in psychotics.**—Madeline R. Lockwood. *Jour. of Ment. Sci.*, 1932, lxxviii, 288.

This reflex, being an inevitable response and outside voluntary control, can be used to supply objective evidence of affectivity. A parallelism was shown to exist in psychotics between the affective state, as determined by the galvanometer, and the hyperglycæmic index. States of increased emotional tension and consequent increased galvanic reactivity were associated with a sufficient increase of functional activity to cause a rise in the index. Conditions in which clinical signs of increased emotional tension were accompanied by any rise in the index were found to give normal or decreased galvanic reactions. Like the index, the affectivity as shown by the galvanometer was found to depend, not upon the type of psychosis, but upon the degree of emotional tension present at the time of the test. The percentage

number of the deflections obtained during the word-association test varied approximately with the affectivity of the subject and can fairly be used as a means of comparison between different patients, provided the sensitivity of the galvanometer be kept constant.

C. S. R.

PSYCHOPATHOLOGY.

[33] **Alzheimer's disease: Its occurrence on the basis of a variety of etiological factors.**—K. LOWENBERG and D. ROTHSCHILD. *Amer. Jour. Psychiat.*, 1931, xi, 269.

Two cases of Alzheimer's disease are reported. Although atypical in some respects, clinically and pathologically there were adequate grounds for classifying them under this heading. In the first case the Alzheimer disease picture was superimposed upon a chronic syphilitic meningitis in a feebleminded person. In addition, the brain showed cerebral hemiatrophy. This was thought to represent the anatomical substratum of the feebleminded-ness. In the second case there were certain clinical features which seemed entirely inconsistent with a presenile disorder. Here the etiological factor was regarded as toxic. These observations, taken in conjunction with others in the literature, lead to the conclusion that Alzheimer's disease is really a syndrome with a multiplicity of etiological factors. The majority of the cases must still be brought into relation with atypical senile processes. However, there is a smaller group in which the causative agents appear to be toxic or organic diseases that are clearly independent of senility or allied conditions.

C. S. R.

[34] **Pick's disease (circumscribed senile atrophy) and Alzheimer's disease.**—F. T. THORPE. *Jour. of Ment. Sci.*, 1932, lxxviii, 302.

A MARRIED woman, whose family history was negative, began to show definite signs of failing memory at the age of 56. She had previously been healthy, capable and efficient, but had always been a little absent-minded. Forgetfulness and periods of confusion gradually increased, necessitating certification at the age of 59. Later she showed agitation, extreme confusion, complete disorientation and incoherent chattering. Profound dementia was established and death ensued at the age of 62. The terminal state was characterized by epileptiform convulsions. The brain showed gross atrophy without regional emphasis. Arteriosclerosis was absent. Histologically, numerous senile plaques were found scattered throughout the cortex. There was marked diminution in the number of nerve-cells. Alzheimer's fibrillary changes were also present.

C. S. R.

[35] **The distribution of calcium between blood and cerebrospinal fluid in mental diseases.**—S. KATZENELBOGEN and H. GOLDSMITH. *Amer. Jour. Psychiat.*, 1931, xi, 9.

THE blood calcium in organic psychosis ranges between 8·1 and 10·9 mgm. per cent. Figures below the normal level have been found in 8 out of 42 cases of organic psychosis. In schizophrenia, manic-depressive psychosis and mental deficiency blood calcium was found to be within normal limits. The cerebrospinal fluid calcium showed a slight deviation below the normal in 4 out of 40 cases of schizophrenia and a moderate rise in 3 out of 42 cases of organic psychosis. In manic-depressive psychosis (10 cases) and mental deficiency (21 cases) only normal figures were found. Slightly increased ratios of fluid calcium with blood calcium were elicited in 5 out of 42 cases of organic psychosis. In the schizophrenic group ratios below normal were observed in 4 out of 40 cases. In manic-depressive insanity and mental deficiency the ratios are within normal limits. The contents in blood and cerebrospinal fluid and the distribution ratios of calcium can hardly be helpful for the diagnosis, since abnormal figures have been found only in a small number of cases. The passage of calcium from blood into fluid follows the trend of bromide, which is a tendency to an increased permeability in organic psychosis and a low permeability in schizophrenia. This similar behaviour of calcium and bromide contributes to the view that the hæmatoencephalic barrier functions somewhat differently in schizophrenia and organic psychosis. The abnormal barrier permeability found in various heterogeneous pathological conditions suggests that the dysfunction of the barrier is not altogether specific to certain nervous and mental diseases but presents a partial malfunction of a diseased organism. C. S. R.

PROGNOSIS AND TREATMENT.

[36] **Grading of patients in mental hospitals as a therapeutic measure**—MILTON H. ERICKSON and R. G. HOSKINS. *Amer. Jour. Psychiat.*, 1931, xi, 103.

A PLAN is described that is in successful operation as one feature in situational therapy in a research service devoted to the study of schizophrenia. The patients are formally divided into six groups in accordance with their psychiatric status. Each group is described in terms comprehensible to the patients, and to each group is assigned a grade letter. Patients are promoted or demoted from grade to grade in accordance with changes in the mental condition. All promotions and demotions are given ward publicity. This is an effective method of motivating efforts towards self-improvement and of stimulating hope in the individual patient. The method is widely applicable to state hospital practice, and yields excellent therapeutic results for the effort expended. C. S. R.

Reviews and Notices of Books.

Constitution-Types in Delinquency. By W. A. Willemse, M.A., Dr. Phil., Lecturer in Psychology, University of Pretoria. London: Kegan Paul. 1932. Pp. 266. Price 15s. net.

With the increasing knowledge of psychopathology during the last thirty years the attitude of society towards crime has undergone a very considerable change. More and more has it come to be recognized that many criminals are abnormal persons, the motives for whose conduct have been determined primarily by defects or deficiencies in their mental or physical make-up. Investigations of criminals by psychophysical methods have led to modifications of criminal procedure and punishment, and have indicated the lines on which preventive measures can be applied to juvenile and adolescent classes. This book embodies such an investigation, and the first aim of the author has been to apply the psychological typology of Kretschmer to male juvenile delinquents. A careful study was made of the inmates of a reformatory comprising rather less than two hundred boys between the ages of 16 and 21 years, those of lower age being excluded owing to the greater difficulty of recognizing types before puberty. Psychotechnical tests, including mechanical aptitude, finger and manual skill, drawing, memory for forms and instructions, insight into concrete spatial relations, etc., were applied; the boys were observed daily in their debating society meetings, swimming pool, sports ground and work; and some 700 letters written by them over a period of two and a half months were read without their knowledge. Finally, each boy was photographed, measured and described anthropometrically.

The greater part of the book is devoted to the results of the investigation, separate chapters being given to the mental qualities of the schizo-type, athletic, pycnic and dysplastic types. The autism of the schizo-type is manifested in delinquency as a tendency to commit offences solitarily, self-conscious compensations, cowardly acts, silent scheming and sexual maladjustments; athletic criminals are dangerous, perpetrate undaunted criminal acts and are unscrupulously calculative; pycnics often become leaders of criminal gangs and show their characteristics by hasty aggressions, squandering money, sexual excess and alcoholic intemperance.

The second object of the author is to coordinate the biotypologies of Kretschmer, Jaensch, Pende, Berman, Wiersma and others, in so far as there appears to be similarity between the underlying biological principles of these typologies and those of Kretschmer's typology. Incidentally he hopes thereby to direct the attention of English and American investigators to bio-typological studies now being made at different centres on the continent.

This work, which is one of the products of investigations made by the Institute on vocational, industrial and social adjustment of juveniles, is interesting and suggestive. That a considerable degree of correlation appears to exist between mental and physical characteristics is widely recognized, and, though much work has been done on the subject, there is still a large field for research. Kretschmer's studies afford a useful basis for further investigations such as this of Dr. Willemse, but the existence of intermediate types of every variety of mixture shows that the criteria for a scientific classification are still lacking. In such circumstances the application of unmeasurable entities such as mental qualities is all the more difficult. The author has made a commendable attempt to add to our knowledge of a complex subject and his excellent photographs materially assist his descriptions.

T. R. H.

Fields of Psychology: A Study of Man and his Environment. By GLENN DEVERE HIGGINSON, Assistant Professor of Psychology, University of Illinois. London: George Allen & Unwin. 1931. Pp. 631. Price 15s.

THIS book is of a type rather uncommon in present-day psychological literature. It attempts to give an impression of the whole position and scope of both normal and pathological psychology by presenting the theories, so often conflicting, of the various schools; the questions thus raised being dispassionately and, in most cases, thoroughly, discussed. Conflicting views are contrasted, and in attempting to reconcile them the author does not hesitate to express his own opinions. His attitude, however, is very moderate, and the reader is impressed by his psychological insight and his scientific spirit.

The book also deals extensively with matters that are, strictly speaking, outside the domain of psychology. Thus it opens with a good chapter on the origin and nature of science in which the place of psychology among the sciences is discussed. Then there is a long section on problems of development in which evolutionary hypotheses are expounded and their significance for psychology indicated. This section contains much interesting

information on comparative psychology and embryology, and there is an excellent chapter on anthropology.

The psychological aspects of education, efficiency, advertising, and delinquency are then dealt with, and the final part of the book, some 117 pages, consists of a necessarily short but balanced account of modern psychopathology and psychotherapy.

Covering so wide a ground in so much detail, the book contains a large amount of data bearing upon, but not of, psychology and should thus prove valuable as a source of reference to all psychologists. As an introduction for students it should assist them to get what so many of them fail to achieve —a broad, comprehensive view of psychology as a whole. Not the least valuable feature of the book is its very complete bibliography.

T. R. H.

Psychopathology of Forced Movements in Oculogyric Crises. By SMITH ELY JELLIFFE. New York and Washington: Nervous and Mental Diseases Publishing Co. 1932. Pp. 219. Price $4.

WITH remarkable industry Dr. Jelliffe has collected and recorded in preçis the case-histories of perhaps 200 examples of oculogyric crises occurring in connexion with epidemic encephalitis. While most neurologists consider that typical instances of the condition are found only in that morbid affection Dr. Jelliffe will not have it so; he links with the syndrome other states, and, indeed, other phenomena, that might properly be regarded as foreign to it. However this may be (and it is not, perhaps, of prime importance), Dr. Jelliffe's view is, apparently, that the ocular movements concerned have a ' meaning '; he believes that all manifestations of ' behaviour ' (' be it of kidney, bone, muscle, speech, ocular movement,' etc.) have a ' meaning,' to understand which ' the entire organic unity of the human body and its milieu must be taken into account.' For him, therefore, the ' meaning ' of oculogyric crises can only be discovered by roaming far afield. We are not surprised, accordingly, to find it stated that they cannot be ' understood ' without study of concomitant mental states which show a trend towards ' complete retreat from reality.' ' Is it not a chimæra to believe that any bit of behaviour . . . can be adequately understood if the mental states, conscious and/or unconscious, are left out of the picture?' Some idea, possibly, of what is intended can be gathered from the ' meaning ' attached by Dr. Jelliffe to the downward movement of the eyes in a particular case: ' the lowering of the eyes is quite typical of the attitude of maidenly modesty —attitude of the virgin-prostitute ambivalence.' The phenomena are compulsion phenomena, and their ' meaning ' is always to be interpreted by a consideration of the ' interaction of the ego, the super-ego, and the id.'

This, we believe, represents in some degree the thesis which Dr. Jelliffe offers for consideration; but his ideas and notions are frequently expressed in language so involved and obscure, his style is often so diffuse, and German terms and words are so peculiarly interlarded as to make it difficult to ascertain what he would really be at. His general views on the interpretation of oculogyric spasms are not likely to gain adherents except from among those who already envisage all the activities of the nervous system through the spectacles of metapsychology. Dr. Jelliffe occasionally speaks rather hardly of those whose opinions do not tally with his own; a favourite adjective to describe these contributions is 'naive.' But as he alleges that the relation of neurology to psychiatry is as the relation of arithmetic to the calculus, he doubtless feels impatient with neurologists who see no 'meaning' of the kind he so keenly traces in the spasmodic movements of ocular muscles.

Fraud in Medico-legal Practice. By Sir JOHN COLLIE, C.M.G., M.D., etc., formerly Medical Examiner to the London County Council, etc. London: Edward Arnold and Co. 1932. Pp. 276. Price 10s. 6d.

FEW medical men have had better or richer opportunities for studying the seamy side of human nature from the angle of nosological fraud than the distinguished author of this very readable production, which is filled with tragi-comic instances of feigned and simulated 'diseases.' It testifies abundantly to the ingenuity of mankind if at the same time exhibiting man's attitude towards his own ailments or incapacities in an unfavourable light. He who finds reason for cynicism in this behaviour will doubtless read these pages with glee; some of the records almost surpass belief. But there is another side to the question, for the desire to make capital out of infirmity becomes at times almost pathetic. From a strictly medical and diagnostic standpoint much of the information here tabulated for purposes of contrast is of undoubted value; on the other hand, we think some of the author's statements a little dogmatic and some of his conclusions scarcely warranted. But the range of his knowledge is astonishing, and his skill in outwitting the contentions of his examinees admirable. Only an acute observer could on so many occasions have seen through the pretentious claims advanced with cleverness if not always with intelligence. We wish Sir John Collie had dealt more at length with the difficult question of conscious as opposed to unconscious self-deception, and more, too, with unconscious motives. But we congratulate him cordially on his valuable exposé of fraud in all its aspects, and on his putting into the hands of the profession an instrument for its detection.

Diagnostik der Hirngeschwulste. By Prof. Dr. KURT GOLDSTEIN, Berlin, and Dr. HANS COHN, Frankfurt. Berlin and Vienna: Urban and Schwarzenberg. 1932. Pp. 138. Price RM. 12.

THIS monograph gives the reader a more or less complete and up-to-date résumé of diagnostic technique in respect of intracranial tumours; it is well printed and beautifully illustrated. The first division of the work takes up seriatim the signs and symptoms of cerebral growth, dealing at length with all the examinations considered serviceable to-day, inclusive of ventriculography and encephalography, investigation of eye, ear, nose, blood, and spinal fluid, and so forth. In the second part are provided a series of chapters in which the topical diagnosis of tumours of different regions is excellently set forth.

We have formed a high opinion of the merits of this contribution, which carries the mark of personal study and is rendered additionally helpful by its many references to the literature. It covers a widening field in comprehensive fashion, and amply proves the necessity of utilizing every known means of diagnosis before any case is submitted to operation.

Introduction à la Chirurgie Nerveuse. By E. E. LAUWERS. Paris: Masson et Cie. 1932. Pp. 120. Price 25 fr.

ADVANCES of recent years in the surgery of the nervous system are being reflected in a series of monographs and treatises dealing with the subject on wide and general lines. The slender volume of Professor Lauwers describes in succinct fashion the relations of present-day neurosurgery to various neurological conditions, but the author is no less concerned with the physiology and semeiology of these states. Indeed, he writes more as a neurologist than as a surgeon, giving the impression of familiarity with his topics and full appreciation of their clinical bearing. His aim is to base neurosurgery on knowledge of the nervous system in health and disease; the volume therefore is to be considered as an introduction, and no more. From this viewpoint it is well conceived and well written.

Les Troubles du Sommeil. By HENRI ROGER, Professor of Nervous Diseases in the Faculty of Medicine, Marseilles. Paris: Masson et Cie. 1932. Pp. 206. Price 20 fr.

A CONVENIENT pocket-size vademecum written by Professor Roger deals in a systematized way with the insomnias and hypersomnias, their causation, clinical symptoms, and treatment; the second part is devoted to the parasomnias. These include such ' psychical ' disorders as night terrors,

nightmares, and somnambulism; ' cerebrospinal ' disturbances such as teeth-grinding, nocturnal restlessness, tics and rhythmias of sleep; and ' sympathetic ' syndromes such as nocturnal enuresis, cramps, and other phenomena considered to develop mainly at night. A division of this kind has its merits but from the standpoint of etiology leaves something to be desired. The descriptions are clear though sometimes almost too brief for usefulness; the paragraphs on treatment contain numerous helpful suggestions.

Über die Schadelperkussion. By Prof. Dr. L. BENEDEK, Director of the Nerve Clinic, Debreczen. Berlin: S. Karger. 1932. Pp. 112. Price Mk. 6.

BY means of an ingenious and not too elaborate instrument Professor Benedek has sought to standardize and reduce to an objective basis the sounds or notes yielded by the skull on percussion over its different regions. This has required a painstaking study of the different average thicknesses of the cranium in different places. Having obtained a working criterion by taking into consideration all the physical factors, and devised a scheme whereby to mark his findings, he next has tried to register the changes that occur in consequence of neoplastic and other pathological changes within the skull and brain. In this fashion he has endeavoured to add a new procedure to the already wide range of diagnostic technique. Judging by the illustrative cases he provides, we may believe that his claims are based on authentic results. To what extent the method is likely to be adopted can scarcely be predicted, but prima facie it appears worth further investigation.